MODERN PLASTICS

JANUARY 1960



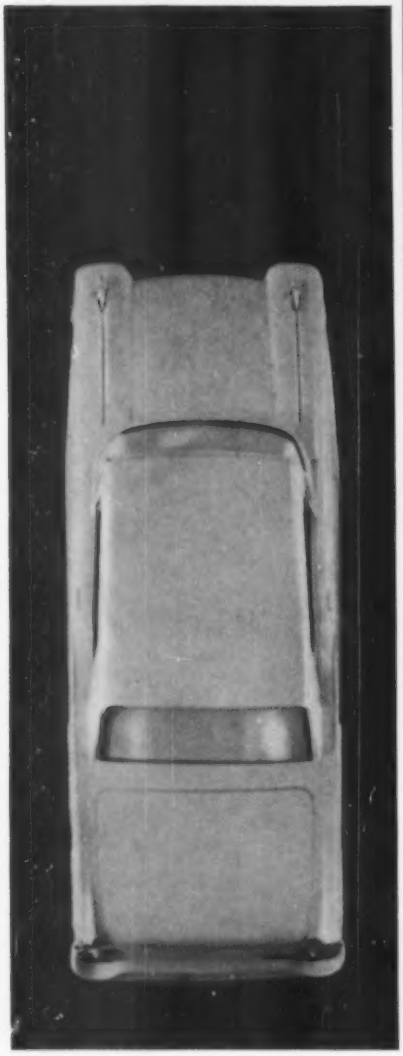
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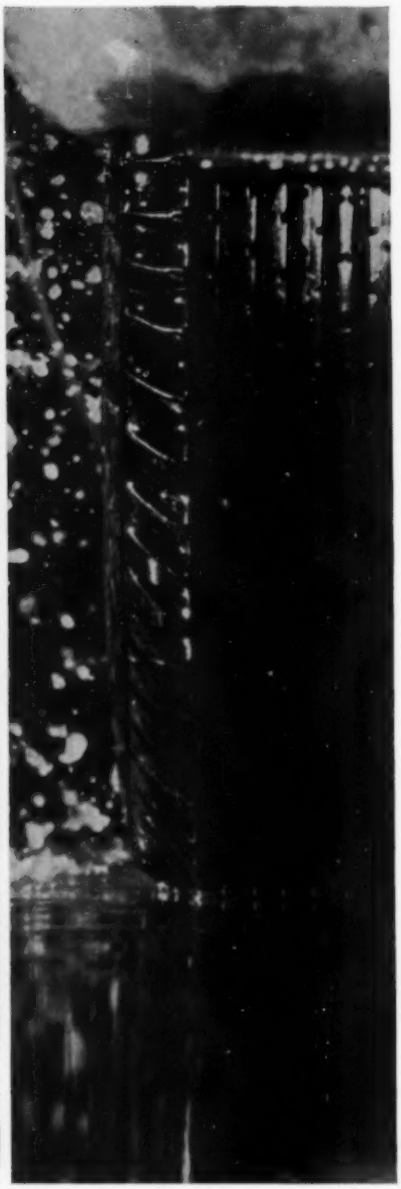
1959 in review—trends for the years ahead in

Materials *p. 89* | **Applications** *p. 113* | **Machines** *p. 131* | **Engineering** *p. 134* | **Technology** *p. 151*

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*Burgess Vibrocrafters, Inc., Grayslake, Illinois

Catalin Corporation of America Catalin **One Park Avenue, New York 16, N. Y.**

MODERN

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After several years of resin and processing developments, applications have finally caught up with technological advances. Result: major breakthroughs in markets traditionally reserved for metals, glass, wood, and other materials. The most significant uses have been culled from developments in 1959 and are discussed in terms of the plastics industry's future growth. Areas covered include reinforced plastics motor housings, building construction, the home, packaging, furniture, cars, luggage, and others.

The next 5 years in plastics **123**

Eight experts forecast trends in the plastics industry for the next 5 years, covering such topics as "Integration—how far, how fast," "Markets for high polymers in 1965," "The future of plastics in construction," "Plastics foams and their market," "Economics and trends in rubber and rubber-like materials," and others.

Plastics in the product revolution—The telephone **126**

First in our new cover series traces the progress made in telephone communication, both in terms of appearance and operation, through constantly growing plastics usage.

Modern Plastics Executive and Editorial Offices: 575 Madison Avenue, New York 22, N.Y. Please mail all correspondence, change of address notices, subscription orders, etc., to above address. Quotations on bulk reprints of articles appearing in this issue are available on request.

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PLASTICS*

JANUARY 1960
Volume 37 Number 5

• ENGINEERING

Machines for plastics **131**

How many injection machines were sold in 1959, how many extruders, compression presses, blow molding machines? Six tables give a definitive listing, broken down by sizes, of total sales, provide a good indication of trends in machine selection. Total number of operable machines in the U. S., classified by type, are also listed.

1959 engineering highlights **134**

Considerable progress has been made in plastics engineering developments during the past year and reported in the literature. The most important ones have been selected from over 30 U. S. and foreign periodicals and are briefly summarized. Taken together, they constitute a complete picture of the status of plastics engineering today. Covered are:

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• TECHNICAL

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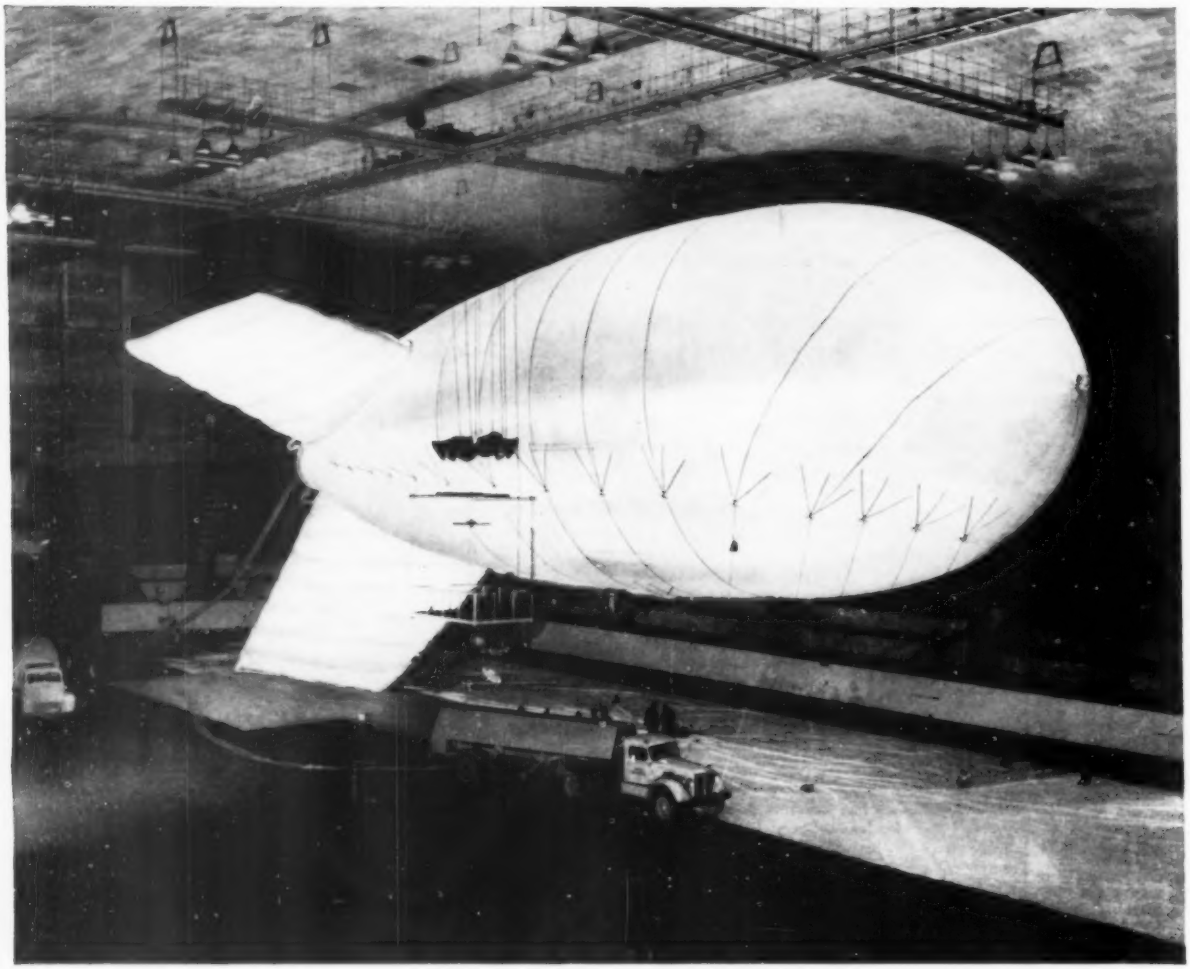
Coming Up . . .

Since the 1960 Reinforced Plastics Conference will be held in Chicago, Feb. 2-4, our February lead article will be a study of progress in and prospects for RP . . . In spite of glass shortages, that industry increased sales by 42.5% in 1959 . . . Features will include a story on sandwiches made without cores by a process similar to the "lost wax" method, a survey of plastics bearings, a new static meter . . . Details on a molded ABS mortar missile used by U. S. Armed Forces as a cost-saving training device . . . Technical Section will publish first test results on a new methacrylate polymer . . . an investigation of microstructure of polymers on magnet wire . . . March lead is to be a comprehensive survey of plastics sandwich structures—kinds, applications and methods . . . April lead will stress plastics colors, colorants, pigments and dyes . . . May's lead feature will be all about plastics alloys, blends, copolymers and multi-polymers.

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Fabric takes to the air in giant Aerocap Balloon



Recently developed by the Mechanical Division of General Mills, a huge balloon made of impregnated fabric now provides a practical means for establishing captive aerial platforms for scientific equipment. Designed for stability and durability under adverse weather conditions, these amazing Aerocaps—the largest of which can lift up to 15,000 pounds—have been used in atomic weapons testing and in elevating radar antennas, acoustical measuring devices and other scientific instrumentation.

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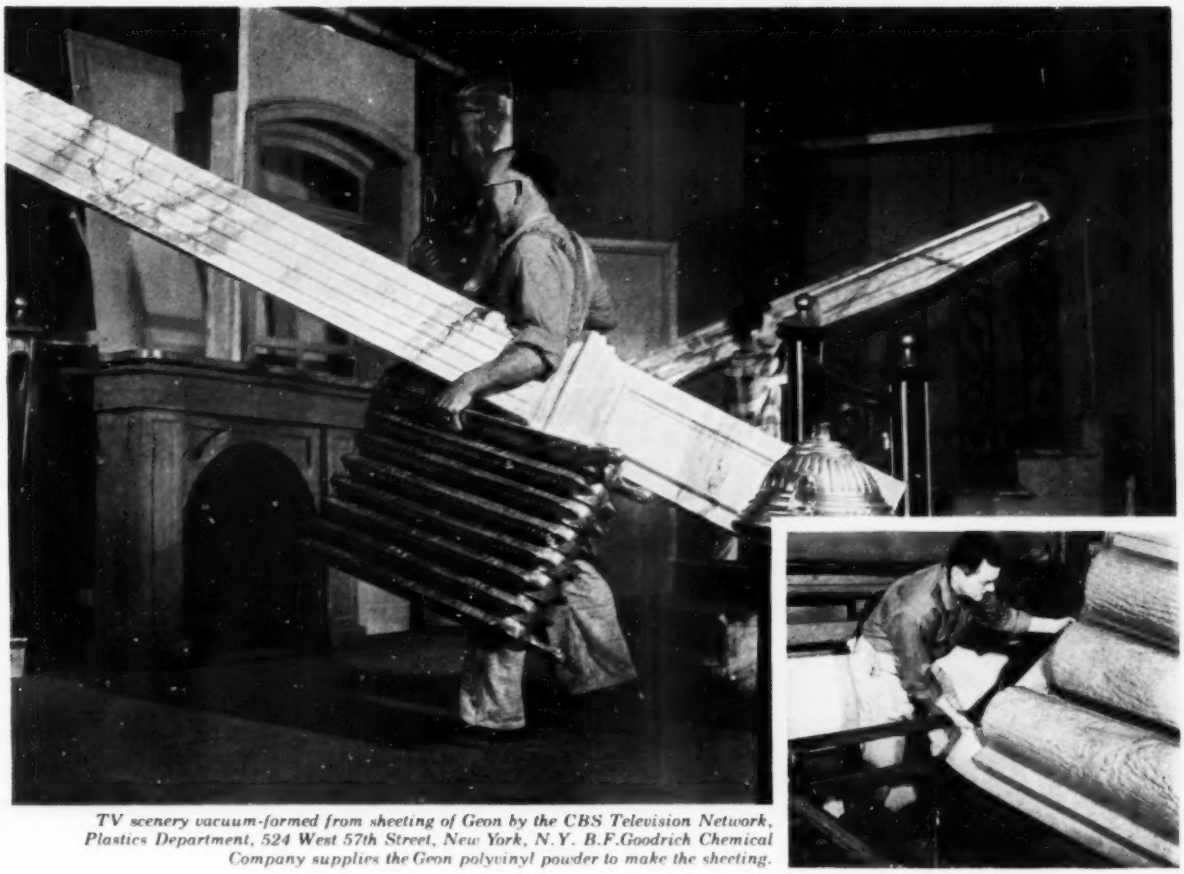
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These stage settings save critical time for TV shows because they are extra lightweight, can be moved faster with less muscle. Vacuum formed of semi-rigid sheet made of Geon polyvinyl material, these settings are remarkably realistic—details of almost any texture and material can be accurately reproduced. For example, brick, rock, wood, metals.

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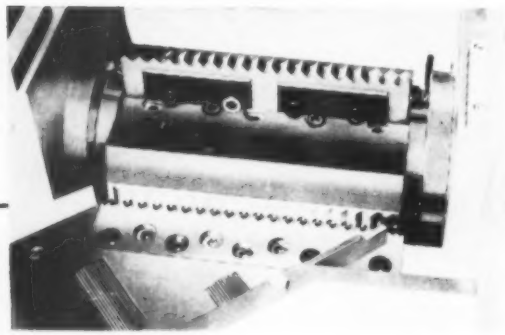
These sets have suggested new possibilities for exhibits or displays where realism and ease of handling are important. Here is another example of how Geon has helped in the making of a new or improved product. Have you an idea? For information, write Dept. GJ-1, B. F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

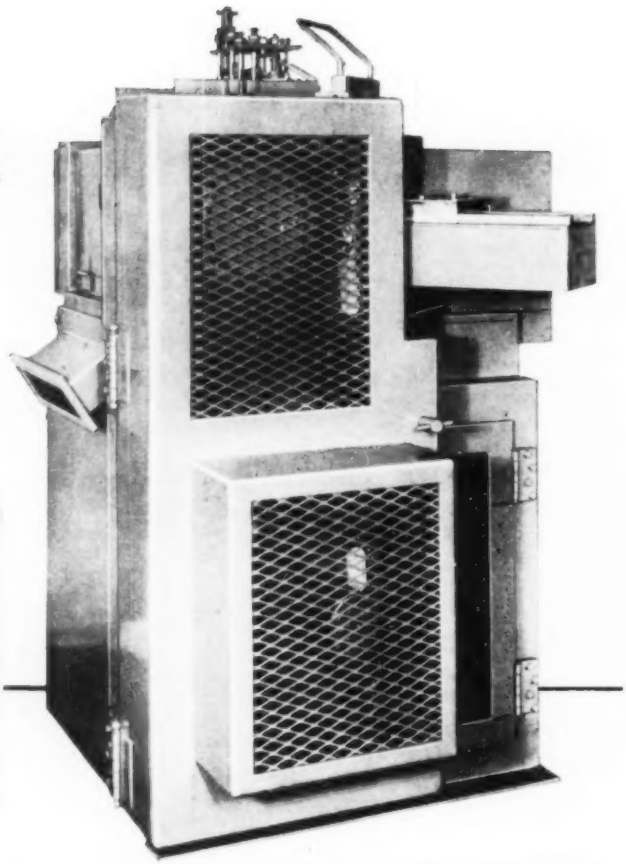


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ENGINEERING COMPANY, INC.

316-7

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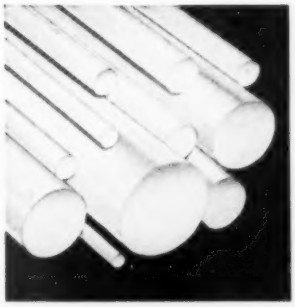
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Cadillac Announcement

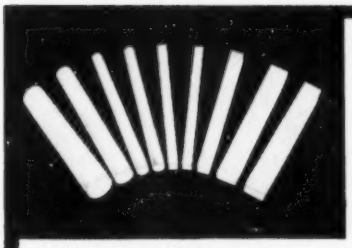
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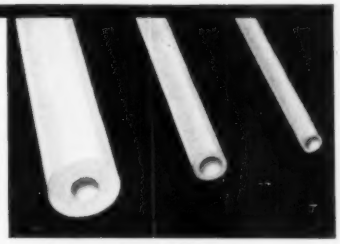
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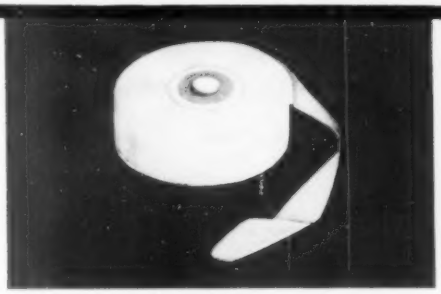
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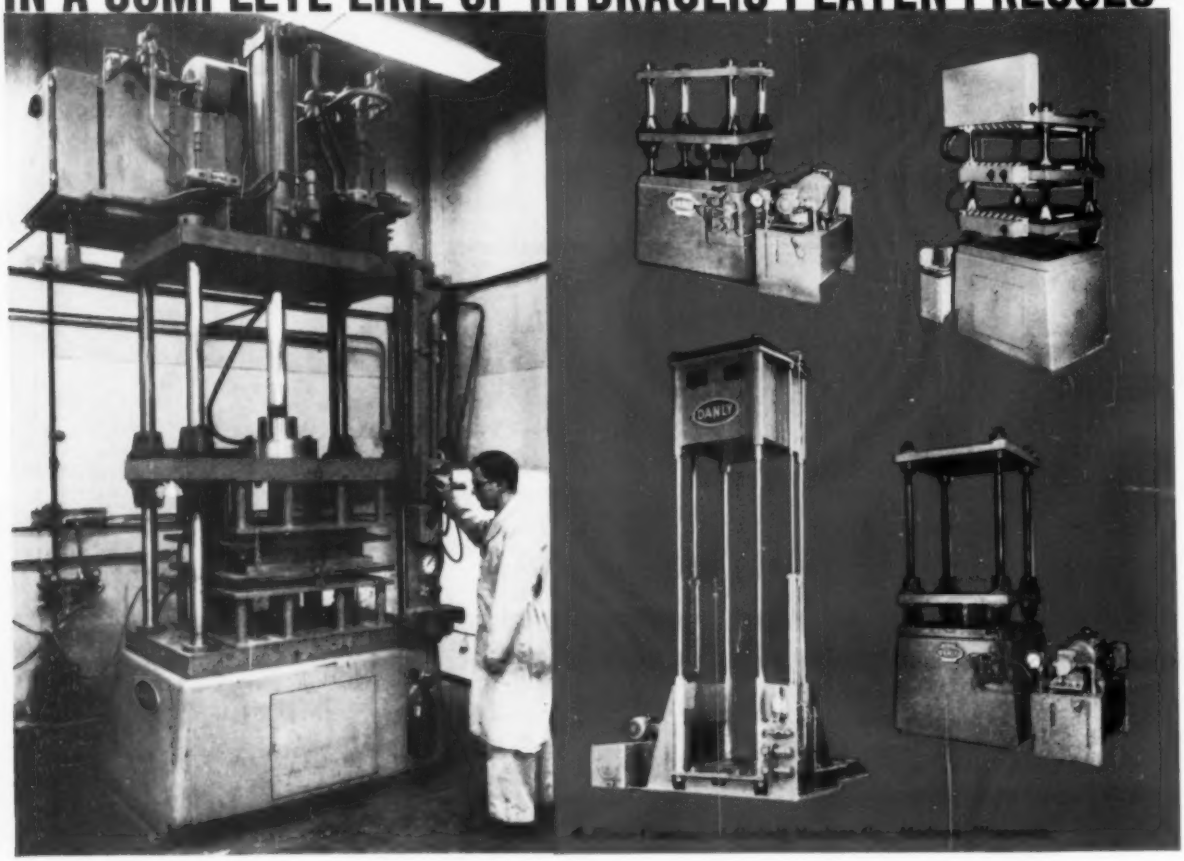
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PHYSICAL PROPERTIES	ASTM METHOD	UNITS	FORTIFLEX RESINS A-20	A-70	A-250	A-500
Melt Index	D-1238-52T	—	0.2	0.7	2.5	5.0
Heat Distortion Temp. (66 psi)	D-648-45T	°F.	185	185	180	180
Brittleness Temp.	D-764-52T	°F.	—200	—180	—160	—100
Impact Strength, Izod (½" x ½" injection-molded bars)	D-256-54T	ft. lb./in. notch	23	18	13	3
Tensile Strength, Max., 0.2 in./min.	D-638-52T	psi.	3700	3600	3500	3300
Elongation, First Tensile Yield Point	D-638-52T	%	25	25	25	25

Properties of Fortiflex "A" Not Affected by Melt Index

PHYSICAL PROPERTIES	ASTM METHOD	UNITS	VALUE
Density		g/cc.	0.96
Refractive Index	D-542-50	n_D^{25}	1.54
Hardness, Shore D	D-676-49T		65
Stiffness	D-747-50	psi.	150,000
Water Absorption (⅛" specimen, 24 hr. immersion @ room temp.)	D-570-54T	%, wgt. gain	<0.01
Flammability	D-635-44	in./min.	1.0
*Mold Shrinkage, length		in./in.	0.03 to 0.05
width		in./in.	0.02 to 0.04

Measured on injection molded tensile bar. Mold shrinkage depends on part design and molding conditions.

Celanese Corporation of America, Plastics Division,
Dept. 101-A, 744 Broad Street, Newark 2, N. J.

Please send: ☐ more information on, ☐ test quantities of Fortiflex.

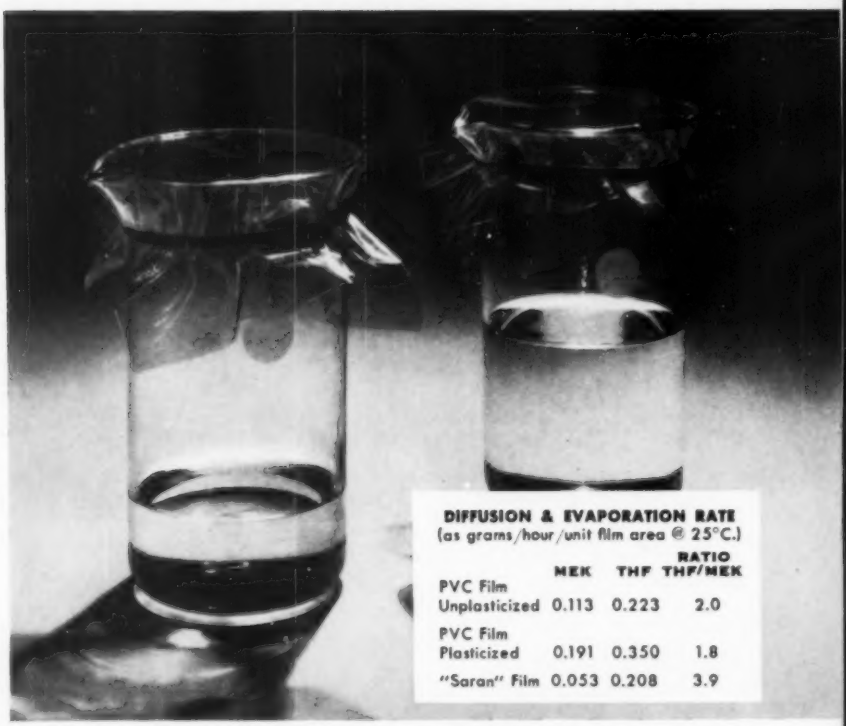
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DIFFUSION & EVAPORATION RATE
(as grams/hour/unit film area @ 25°C.)

	MEK	THF	RATIO THF/MEK
PVC Film Unplasticized	0.113	0.223	2.0
PVC Film Plasticized	0.191	0.350	1.8
"Saran" Film	0.053	0.208	3.9

The two containers above were filled with equal volumes of THF (left) and methyl ethyl ketone (right). Each was covered with a PVC film and allowed to stand for an equal period. Results show THF diffuses through and evaporates from PVC films about twice as fast as MEK.

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THF HAS FAST DIFFUSION & EVAPORATION RATES

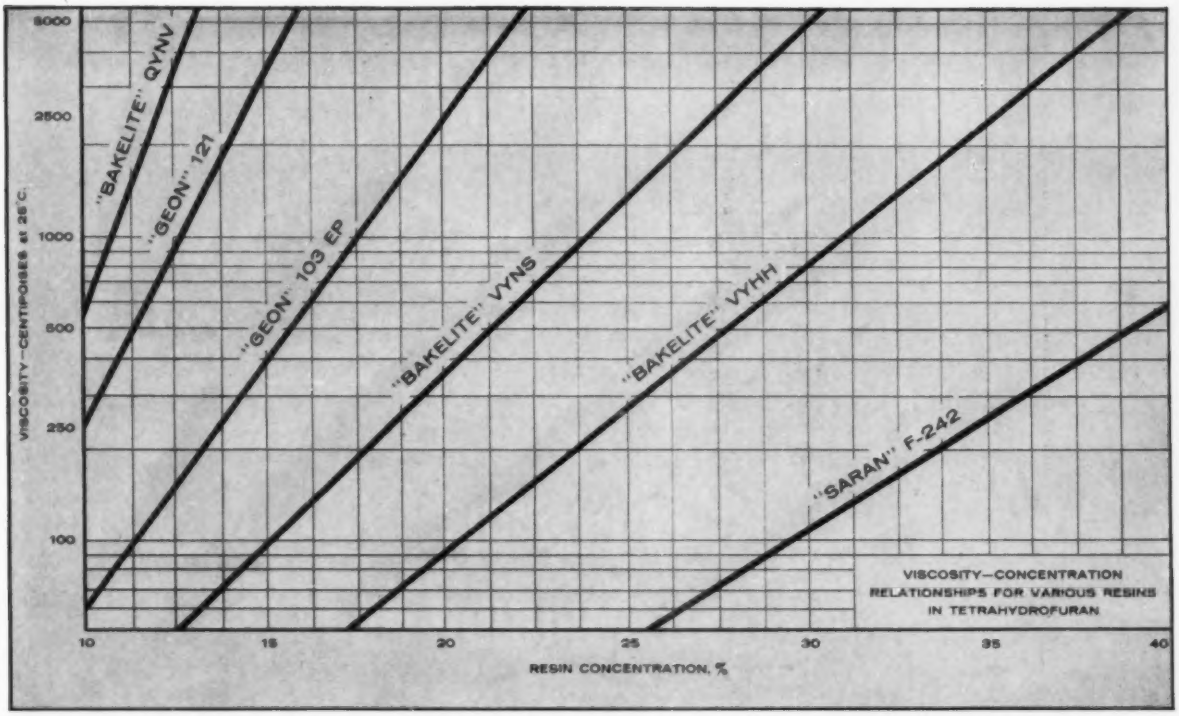
Du Pont tetrahydrofuran diffuses and evaporates more rapidly than a wide range of other commonly used resin solvents . . . up to 2 times as fast as ketone solvents (see above). Drying cycles are reduced, as are problems with residual solvent in coatings and films.

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THF dissolves more PVC resin at room temperature than other solvents: The chart above shows the high percentage of various PVC resins which can be dissolved in tetrahydrofuran.

"Bakelite"—TM Union Carbide & Carbon Corp.
"Geon"—TM B. F. Goodrich Chem. Co.

vinyl product quality Tetrahydrofuran (THF)

THF IS EASILY RECOVERED

Up to 95% of tetrahydrofuran throughput can be recovered from coating, printing and film casting operations. Standard carbon adsorption units constructed of ordinary steel can be used to recover THF, whereas stainless steel equipment is necessary for recovery of many other solvents.

RESULT: *You are assured of minimum solvent loss—low recovery cost. Most existing systems can be modified easily and economically to recover THF.*

THF PROPERTIES

Appearance			Colorless, mobile liquid
Odor			Etherlike
Molecular weight			72.10
Freezing point			-108.52°C.
Boiling range			65°-67°C.
Specific gravity (20°/4°C.)			0.888
Weight, lb./gal. (20°C.)			7.4
Flash point (Tag closed cup)			6°F.
Vapor pressure, mm Hg. at:			
15°C	114	45°C	385
25°C	176	55°C	550
35°C	263	65°C	760
Surface tension, dynes/cm. (25°C.)	26.4		
Solubility	Miscible with water, soluble in most organic solvents		

Use THF to get greater savings and improved quality for all your vinyl products whether they be coatings, films or adhesives. We'll be glad to work with you in developing your particular application for this remarkable solvent. For more information on THF, just drop a line to Du Pont at the address below:

E. I. DU PONT DE NEMOURS & CO. (INC.)
ELECTROCHEMICALS DEPARTMENT
CHLORINE PRODUCTS DIVISION
WILMINGTON 98, DELAWARE

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offers an expanding line of quality industrial chemicals

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How about *you*? Phone or write your nearest Witco representative today for details of any of the products listed below. It pays to buy Witco.

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PIONEER PRODUCTS DIVISION:

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WITCO CHEMICAL COMPANY, CANADA, LTD. (P. N. Soden & Co. Ltd.):

All Organic and Rubber Chemical Products for all consuming industries in Canada

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Photographed with the cooperation of Columbus Coated Fabrics Corp., Columbus, Ohio

Lasting and lustrous—because it's made of PLIOVIC!

Surprising as it may seem, you're looking at a fabric supported vinyl upholstery. It's called *Milano* and, for the first time, combines the soft shimmer of moiré silk with the washability, wearability and general durability of vinyl.

There's no single reason for the distinctive eye- and touch-appeal of this upholstery. It results from a combination of fine skills and materials. But among these materials, PLIOVIC, the basic vinyl resin used, plays a key role.

The primary advantages of using PLIOVIC are: 1. It blends readily, fuses at low temperatures, is generally easy to process. 2. It embosses easily and faithfully. 3. It helps assure lasting adhesion to the knitted fabric backing. Other benefits: Excellent heat- and light-stability plus good over-all physical properties.

Improving the appearance and performance of supported upholstery sheeting is but one of many possible uses for PLIOVIC. How can it help your product? For the answer plus full details on PLIOVIC write: Goodyear, Chemical Division, Dept. M-9422, Akron 16, Ohio.



GOODYEAR

CHEMICAL DIVISION

Pliovic—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

Milano—T. M. Columbus Coated Fabrics Corporation, Columbus, Ohio

In 1959 customers bought more BAKERS than any other make!

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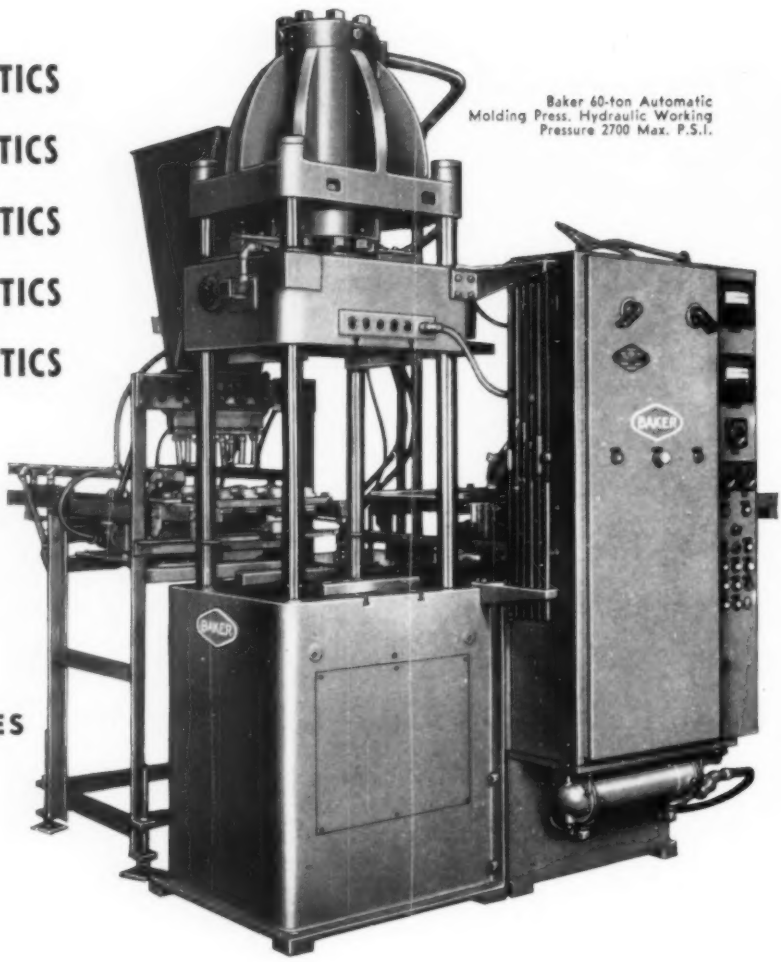
60-TON AUTOMATICS

75-TON AUTOMATICS

100-TON AUTOMATICS

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Baker 60-ton Automatic Molding Press. Hydraulic Working Pressure 2700 Max. P.S.I.

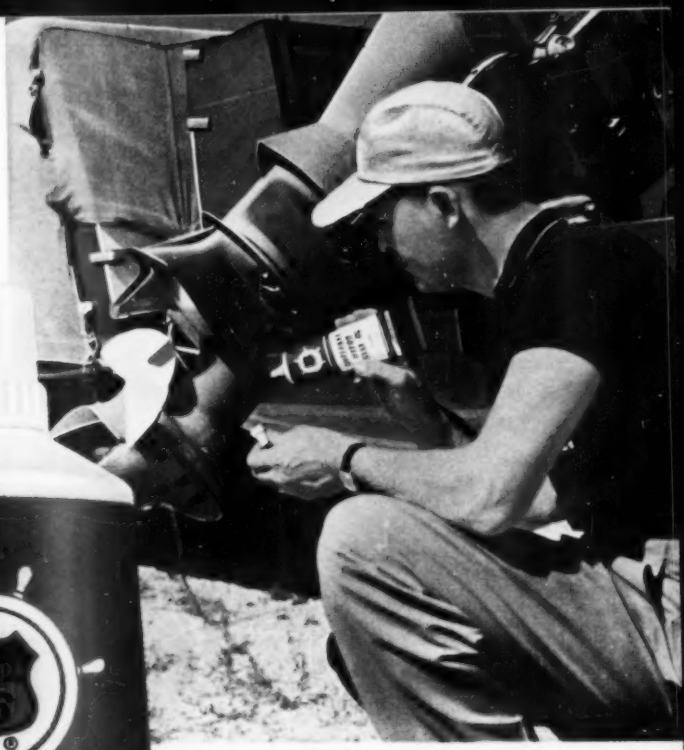
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AUTOMATIC MOLDING MACHINES

In 60, 75, 100, 150, and 175-ton Automatics — Baker led in sales because these machines have what it takes to produce lower piece part prices. Independent upper and lower hydraulic ejection, an automatic safety reflex that stops press if a part fails to eject, time and length of all functions instantly adjustable — these are the reasons more companies are purchasing Bakers. For the full story, write Baker Brothers, Inc., Dept. OP-160, 1010 Post Street, Toledo 10, Ohio.

THE LATEST WORD IN TUBES!

MARLEX*



From its functionally contoured applicator tip to its automatically heat-sealed base, this tube is made of just one material—MARLEX linear polyethylene! No liners... no coatings... no metal closures . . . only 100% pure MARLEX!



Outboard enthusiasts can now buy this superior gear oil packaged in this convenient applicator tube made of MARLEX.

These new tubes made from MARLEX have many advantages. Thin walls give economy, light weight and flexibility of design...superior toughness, gloss and resilience... and excellent shelf life for food, drug and chemical applications!

MARLEX prints beautifully after standard surface preparation. It can be given any color by blending in pigments. These tubes make attractive, eye-catching containers for pastes and liquids. They're ideal for packaging new products . . . giving new sales impact to older products.

Tubes are made of MARLEX by Plax Corporation, Hartford, Connecticut. They can be filled and sealed with standard tube-filling equipment.

MARLEX packaging has outstanding resistance to attack and permeation by moisture vapor, gases, chemicals and oils. These tubes can even be steam-sterilized prior to filling, since MARLEX'S temperature range is −100° to 250° F!

*MARLEX is a trademark for Phillips family of olefin polymers.

PHILLIPS CHEMICAL COMPANY, Bartlesville, Oklahoma

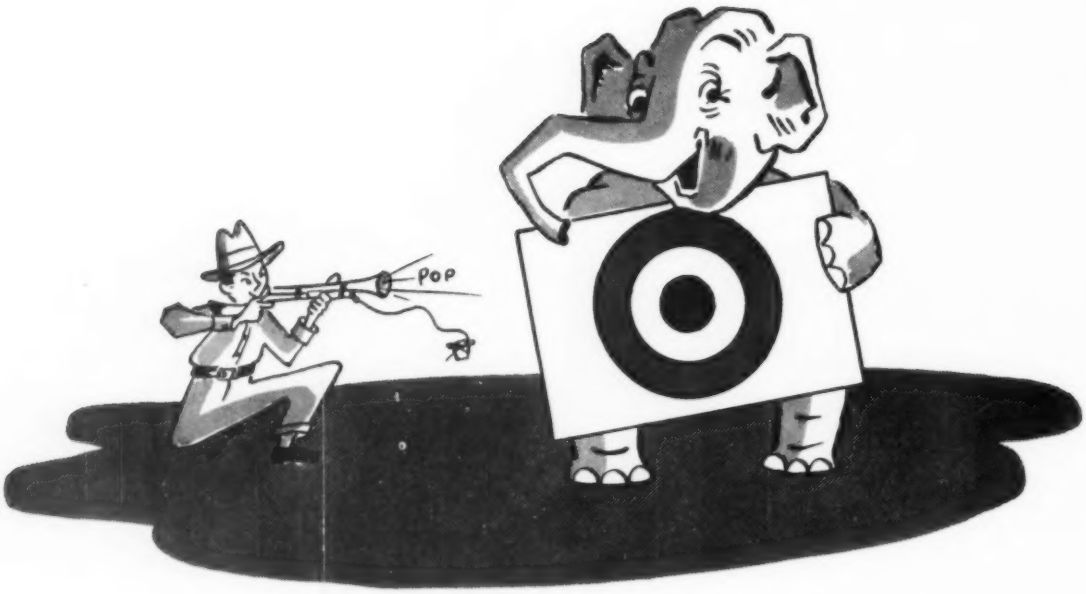
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We at **PEERLESS** know you can't do a sound marking job with inferior equipment. Outdated marking machinery, as you well know, will tend to slow production and make costly errors. Look around your plant . . . decide for yourself whether you're hunting elephants with a pop gun!

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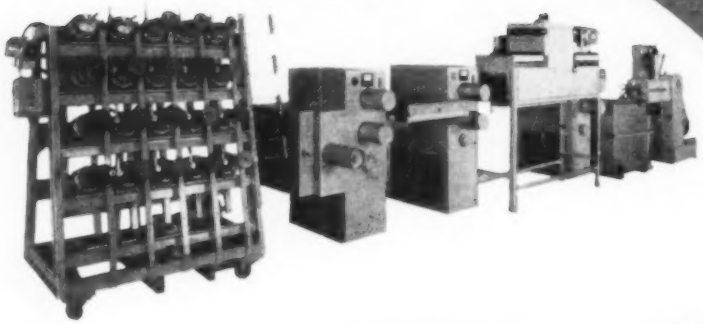
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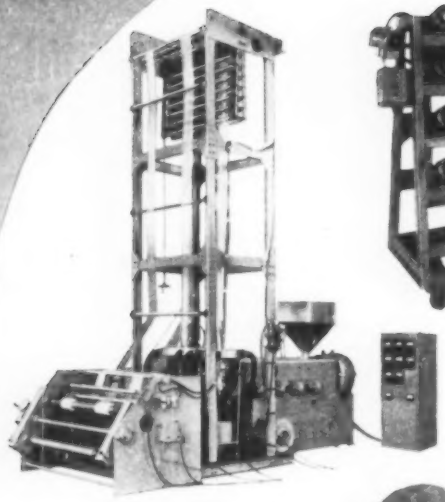
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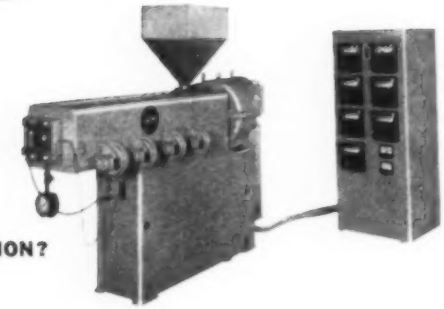




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plastic production problems on your mind?

SYSTEMS—Extruders with twin dies, overhead forming canopy and turret type winder. Sheeting lines of extruder, casting roll unit with turret wind, automatic torque control and high-speed cut-off.

MONOFILAMENTS—Complete packaged monofilament units in all sizes.

MPM HAS THE ANSWERS

CASTING ROLL UNITS—Chrome plated casting rolls, rubber and aluminum pull rolls, trim knives, constant tension double turret winder. For high-speed casting of Polyethylene or Polypropylene in 30", 60", 72", 76", 80" or special widths.

EXTRUDERS—Vented and non-vented with screw sizes from 1" to 12" diameter. All with steel cylinder barrels lined with Xaloy 306 in lengths 16, 20, 24 and 30 times screw diameter.

DIES—Of all types—for blown or sheet film, rods, tubes, pipes, monofilament, and special dies for any extruded product from any plastic material.

Check your needs and contact Modern Plastic Machinery Corporation for complete specifications and product information:

- ☐ Thermoplastic Extruders
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- ☐ Casting Roll Units
- ☐ Sheeting Lines
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- ☐ Dies
- ☐ Conveyers and Cooling Tanks
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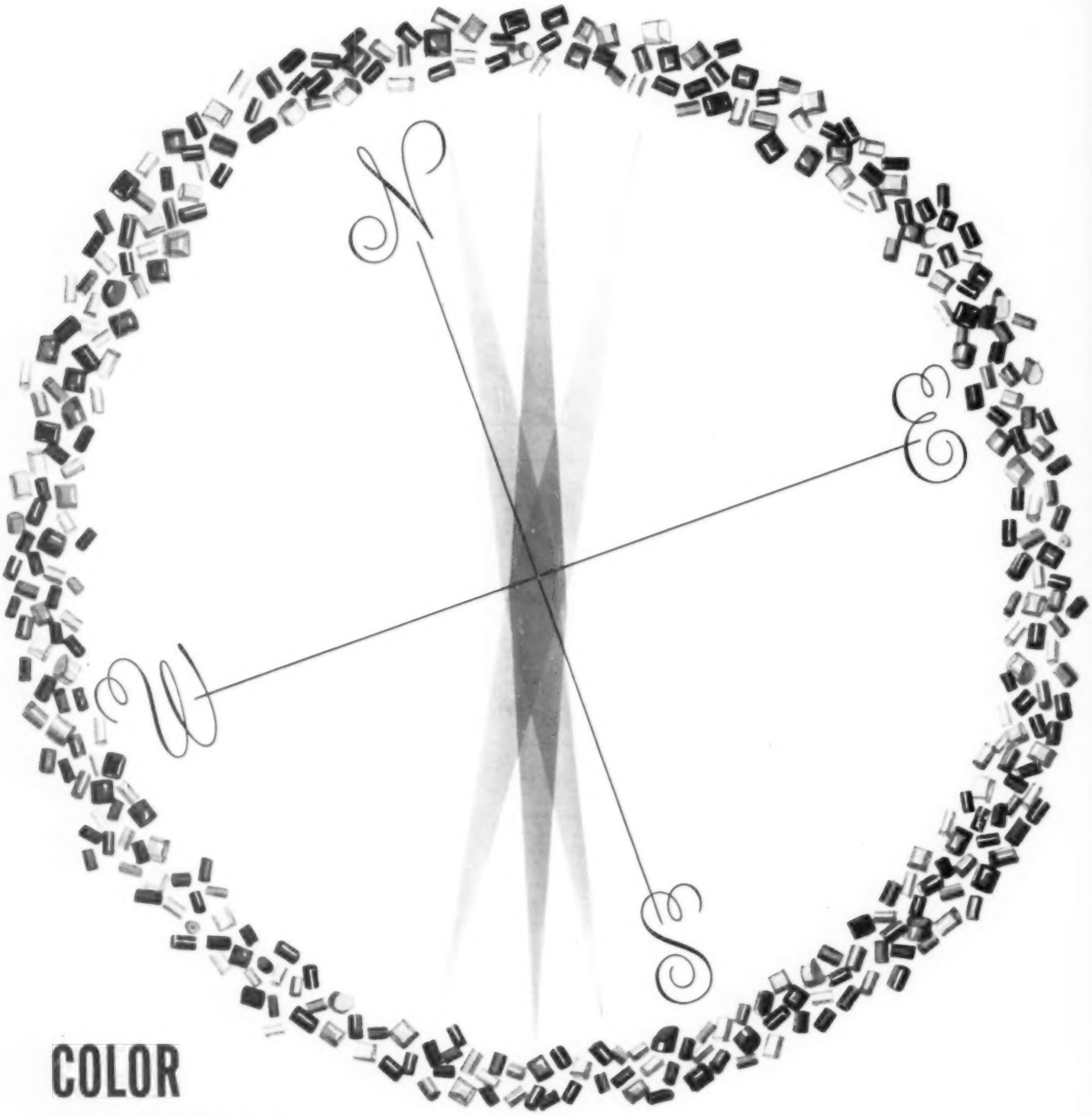
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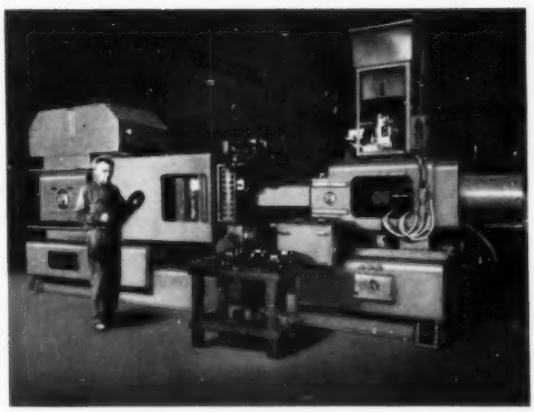
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FABRICON PRODUCTS CHOOSES H-P-Ms FOR THREE NEW OPERATIONS



This automotive air outlet, which requires the full rated capacity of the H-P-M 25/28 oz. for molding, is being produced much faster than anticipated.

When Fabricon Products, Division of Eagle-Picher Co., River Rouge, Michigan, made a decision to enter the custom injection molding field, its choice was standard H-P-M 20/28 oz. machines. Five of these units were ordered, for three strategically located plants, to mold the difficult automotive part shown. In less than two months they were in production. Here's a typical example where H-P-M field and service engineers pitched in to act as consultants, train operators in the use of machines and helped make these departments productive in the shortest possible time.



H-P-M 25/28 oz. machine at work at Fabricon. This machine is equipped with weigh feeder for accurate shot control.

Frank Altman, Fabricon's Director of Engineering, said, "These machines are doing an outstanding job. We like the complete hydraulic action of the entire machine; the easy accessibility to all hydraulics from floor level; their dependability and ease of operation; their excellent cycle time."

There's an H-P-M for your standard requirements, too, and special machine versatility can be incorporated through use of interchangeable components at minimum cost . . . tailored to your specific needs. Write or call today. Get the facts that can mean more profit to you.

THE HYDRAULIC PRESS MANUFACTURING COMPANY
A Division of Koehring Company • Mount Gilead, Ohio, U.S.A.

HPM

H2

NEWEST DESIGN

Unmatched in Performance and Production Features!

Diversamatic
Model B-T24
Twin Head
Blow Molding Machine
(Made in U.S.A., Pat. Pend.)
by
Boston Plastic Machinery, Inc.

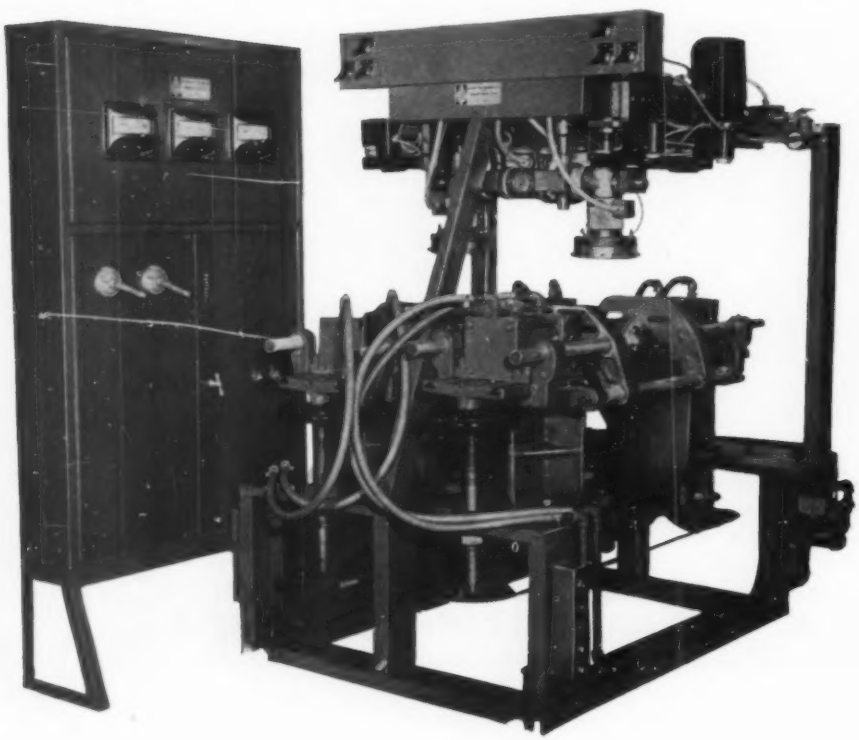
This newest of blow molding machines was designed to equip molders to meet the new challenges that will arise as blow molded products earn their way into more applications every day.

The features listed here outline the production and size capacities, and suggest the great versatility and efficiency of the Diversamatic B-T24. For more detailed information, write for the free booklet that describes the machine and its performance.

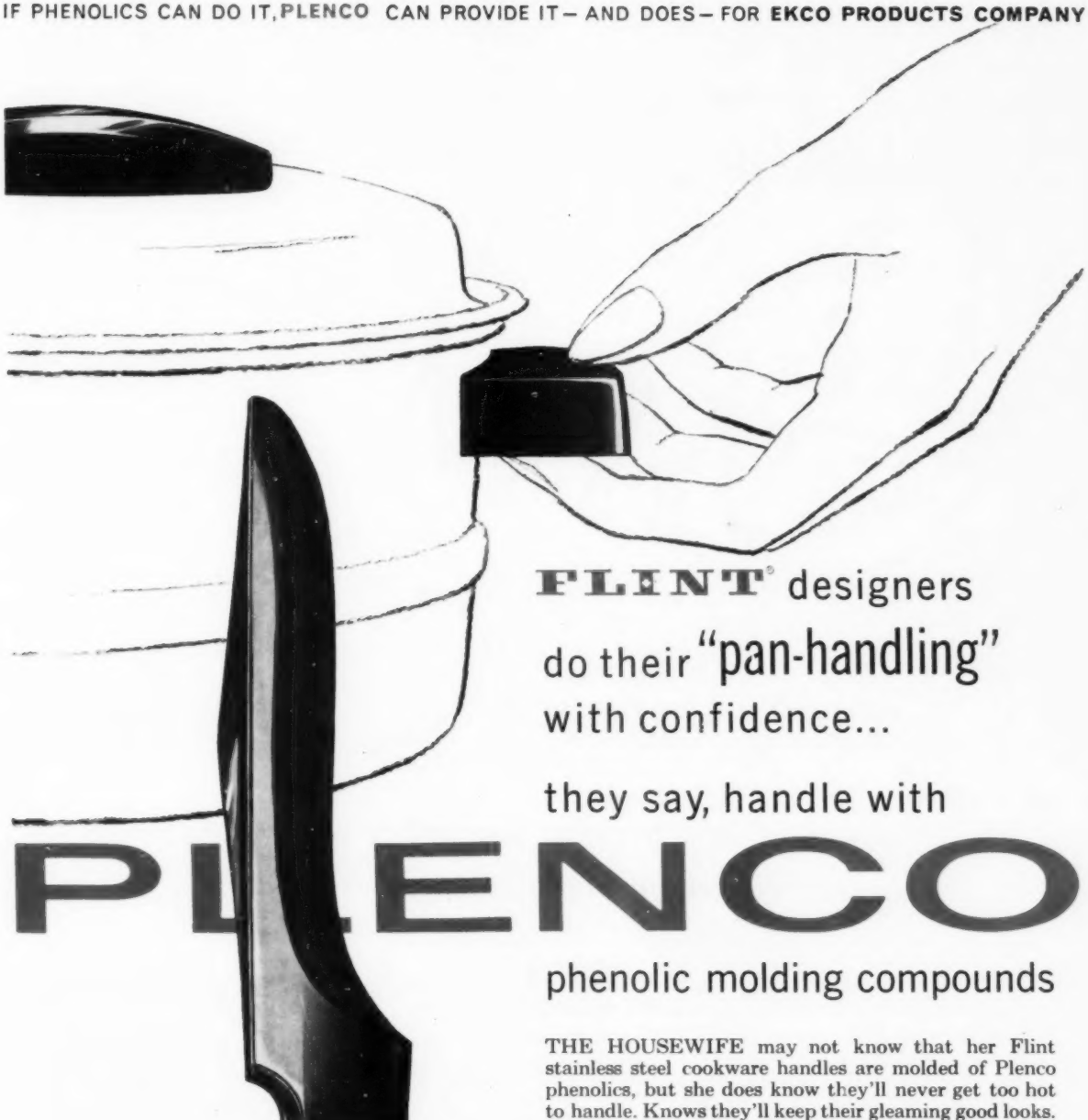
ENGINEERING AND TECHNICAL SERVICES
Boston Plastic Machinery engineers set you up for blow molding operation from item development to production.
We will also custom mold for you, at lowest process, until you have acquired your own machinery.

HIGH PRODUCTION, HIGH VERSATILITY AND HIGH EFFICIENCY FEATURES:
Completely automatic
4 tie bars on each molding station
Hand wheels raise one station for a short die, lower the other to take a 36-inch die.
Super-size capacity handles molds up to 36 inches long, 14 wide, 24 daylight; finished products from 1 to 35 inches long, or vertically strung multiple cavity. Handles parisons from ½ to 4½ inches O.D.
Fast mold change with individually adjustable die closing cylinders
Specially designed manifold with two individually operating extrusion valves
Manual controls for fast set-ups and test runs
Operates with any extruder, domestic or foreign
Continuous or interrupted extrusion
All-pneumatic system; no leaks—fast, clean efficient
Photo-electric safety control

BOSTON PLASTIC MACHINERY, INC.
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IF PHENOLICS CAN DO IT, PLENCO CAN PROVIDE IT – AND DOES – FOR **EKCO PRODUCTS COMPANY**



FLINT® designers
do their "pan-handling"
with confidence...
they say, handle with

PLENCO

phenolic molding compounds

THE HOUSEWIFE may not know that her Flint stainless steel cookware handles are molded of Plenco phenolics, but she does know they'll never get too hot to handle. Knows they'll keep their gleaming good looks. Knows, too, they'll resist wear, shock, acids, grease.

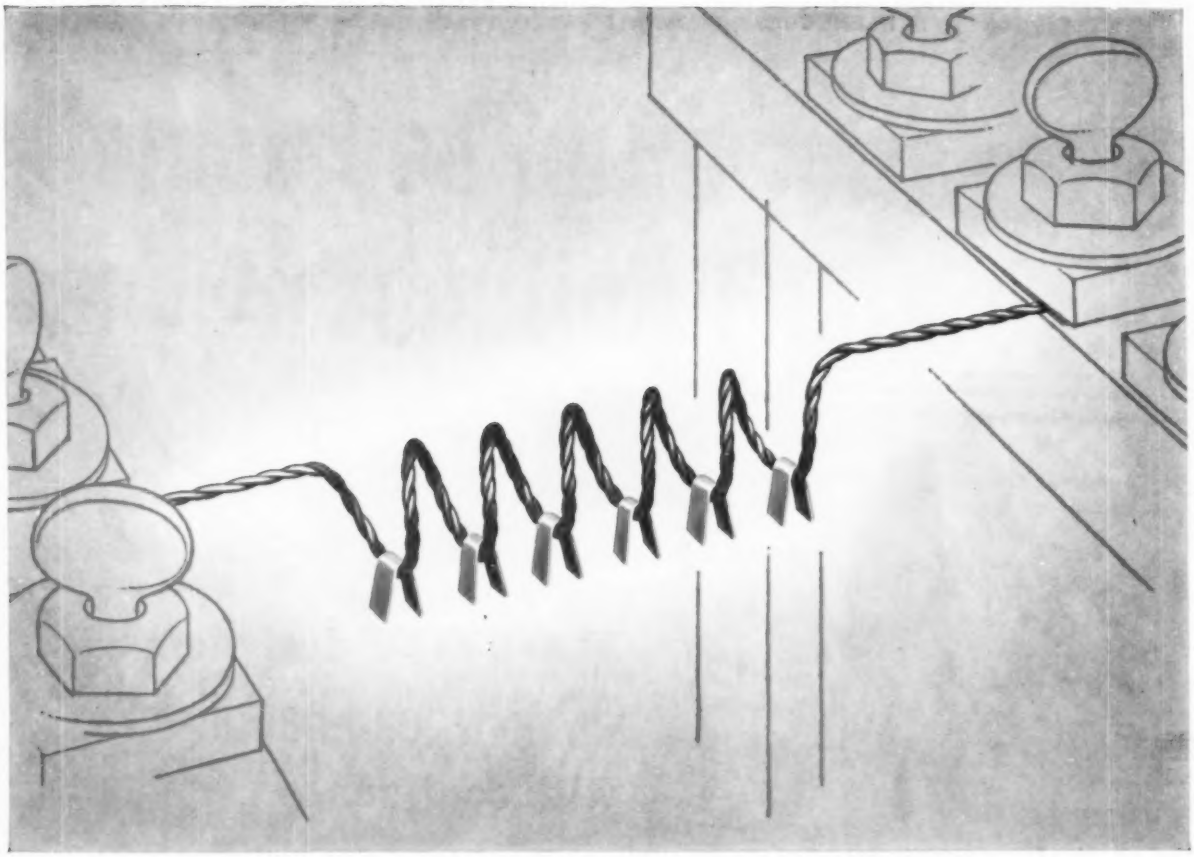
Ekco Products, specifying Plenco 385 H.R. Black for handles, shares her confidence. For a higher-than-general-purpose heat resisting compound, this Plenco material possesses an unusually low specific gravity (1.45). More pieces per pound can be made with it, and the formulation is easy on the mold because of its extremely low mold erosion characteristics.

You can be sure that Plenco, with many years of supplying phenolic compounds to critical and competitive industry, has, or can *custom-formulate* the compound *you* need. We invite you to let us demonstrate that.

PLENCO PHENOLICS
FOR BETTER
PLASTIC PRODUCTS

PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.



New *high-performance tungsten strand makes better vacuum metallizing coils*

Vacuum metallizers who wind their own coils will benefit from the controlled re-crystallization rate built into Sylvania's new metallizing strand. Not only will coils be easier to produce, but they will have a much greater shot life. Controlled re-crystallization reduces brittleness and twisting, minimizing premature breakage during reloading and processing.

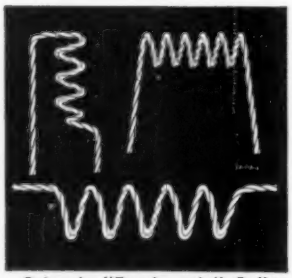
This new Sylvania wire has been thoroughly service-tested in many types of coils. Its uniformity and freedom from splits are assured by electronic quality-control testing during production.

Your Sylvania Field Sales Engineer will be glad to supply you with complete details. Call him now.

These sizes now in production:

No. of strands		Wire Size Inches	No. of strands		Wire Size Inches
2	x	0.030	3	x	0.040
3	x	0.020	4	x	0.015
3	x	0.025	4	x	0.020
3	x	0.030	4	x	0.030
3	x	0.030 (with 0.025" aluminum core)			

Write for new technical bulletin



Sylvania "Readymade" Coils
164 standard types

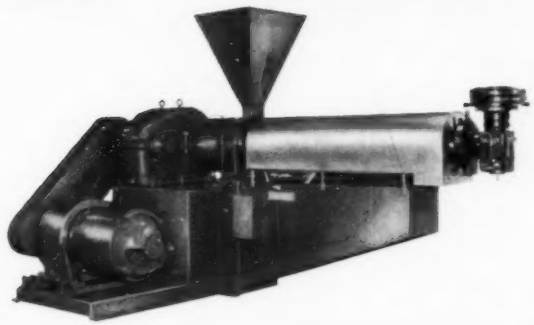
If you prefer, Sylvania will supply precision wound coils in standard shapes and sizes. They're all described in the Sylvania coil catalog. Or let us bid on your special requirements.

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Subsidiary of
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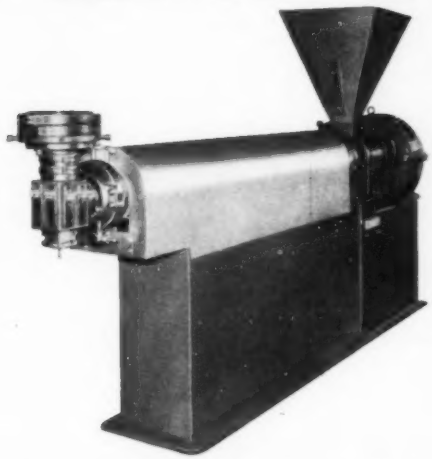
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STERLING



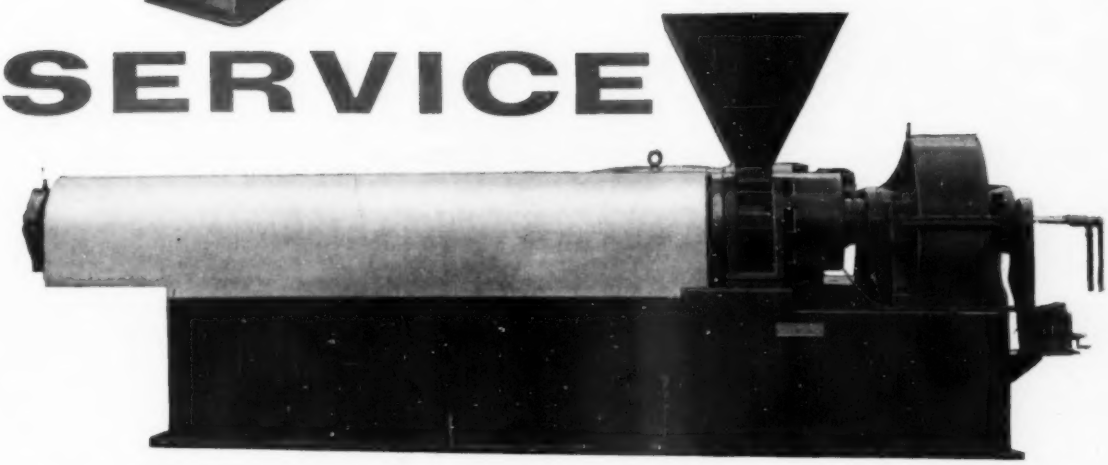
The Sterling Extruder is a superior product which only long experience in the plastics industry could have made possible. Sterlings are available in 1½" through 6" sizes with L/D ratios of 21:1, 24:1, or 30:1.

PERFORMANCE



There are also available—completely packaged units and installations for a variety of standardized and specialized requirements. For full details, write today to Mr. L. D. Yokana, President, Sterling Extruder Corp'n. 1112 Baltimore Avenue, Linden, N.J. WAbash 5-3908.

SERVICE



PRODUCTION

STERLING EXTRUDERS — *"Designed by plastics men for plastics men"*



This is just one of a wide variety of blow molding machines in which Spencer blow molding resins have been successfully run. This Kautex machine is used by Vantines of Flushing, N. Y.

Spencer Chemical Company Announces . . .

"Poly-Eth" 5104 - The Resin Designed For Critical Blow Molding Operations

This newest addition to Spencer's family of blow molding resin offers unusual processing and end product advantages:

To meet the demand for improved polyethylene resins specifically designed for blow molding, Spencer Chemical Company has developed "Poly-Eth" 5104.

This resin has been designed to meet the requirements of the most critical blow molding operations. Molders who are using it are especially enthusiastic about its processing characteristics.

They report it processes exceptionally well in a wide variety of blow molding machines, and gives them the ease of control necessary to produce units to exacting specifications.

Excellent extensability is another advantage found in this resin. Users find it has the necessary flow to fill out evenly into corners without loss of material. This is particularly important in applications involving highly detailed molds.

The end use properties of "Poly-Eth" 5104 include: (1) outstanding stress resistance; (2) low permeability; (3) excellent printability; (4) unusually good appearance; and (5) lack of residual odor. Toys, housewares and bottles produced from 5104 are tough and strong, yet flexible.

For more information about "Poly-Eth" 5104, contact your nearest Spencer Sales Representative, or write direct to Spencer at the address below.

Here Are The Properties Of Spencer's Blow Molding Resins:

Product	Melt Index	Density
"Poly-Eth" 5104	1	.922
"Poly-Eth" 2405	2	.925
"Poly-Eth" 2504	1	.935

SPENCER® **Poly-Eth® Polyethylene**

SPENCER CHEMICAL COMPANY, DWIGHT BLDG., KANSAS CITY, MISSOURI

Decotone is Part of the Picture of the "Room of Tomorrow"

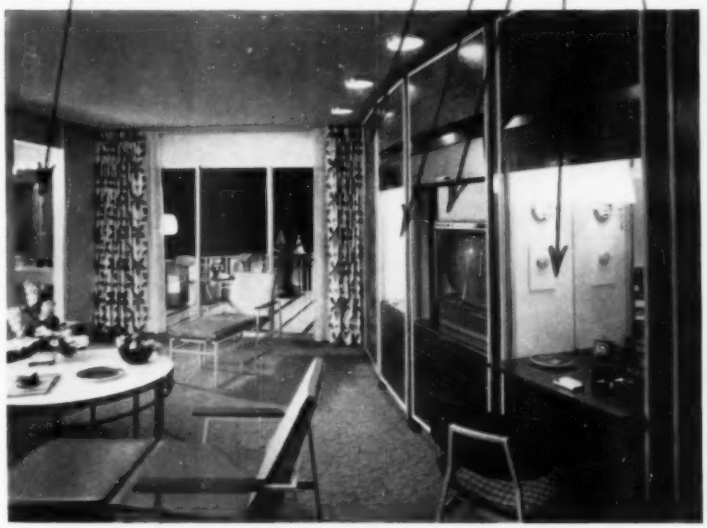
Decotone produced the decorative laminating papers used in making the Parkwood laminates that were a dominant style note of the "1960 Room of Tomorrow" at the National Hotel Exposition at New York's Coliseum last November.

"Rosewood", an exotic tropical woodgrain, and "Raw Silk", a texture effect in abstract pattern, were the two exclusive Parkwood designs featured. They were printed by Decotone's multi-color gravure presses on Fitchburg Laminating Paper, made by its parent mill. These Parkwood laminates cover the entire furniture wall of the "Room of Tomorrow", the doors, counter tops, vanity, and some furniture surfaces.

Decotone is a favored source for the finest in decorated laminating papers.

Furniture wall of five units is panelled in Parkwood's "Rosewood" laminate. Three units have tambour doors which raise at a touch.

Wardrobe door is out of camera range, at right.
The vanity table is in "Raw Silk" design.
Pull-out desk unit.
Television unit.
Mirrored dressing table.
Bar-pantry behind pendiflex doors.



"Room of Tomorrow" designed by Tom Lee, A.I.D., I.D.I.

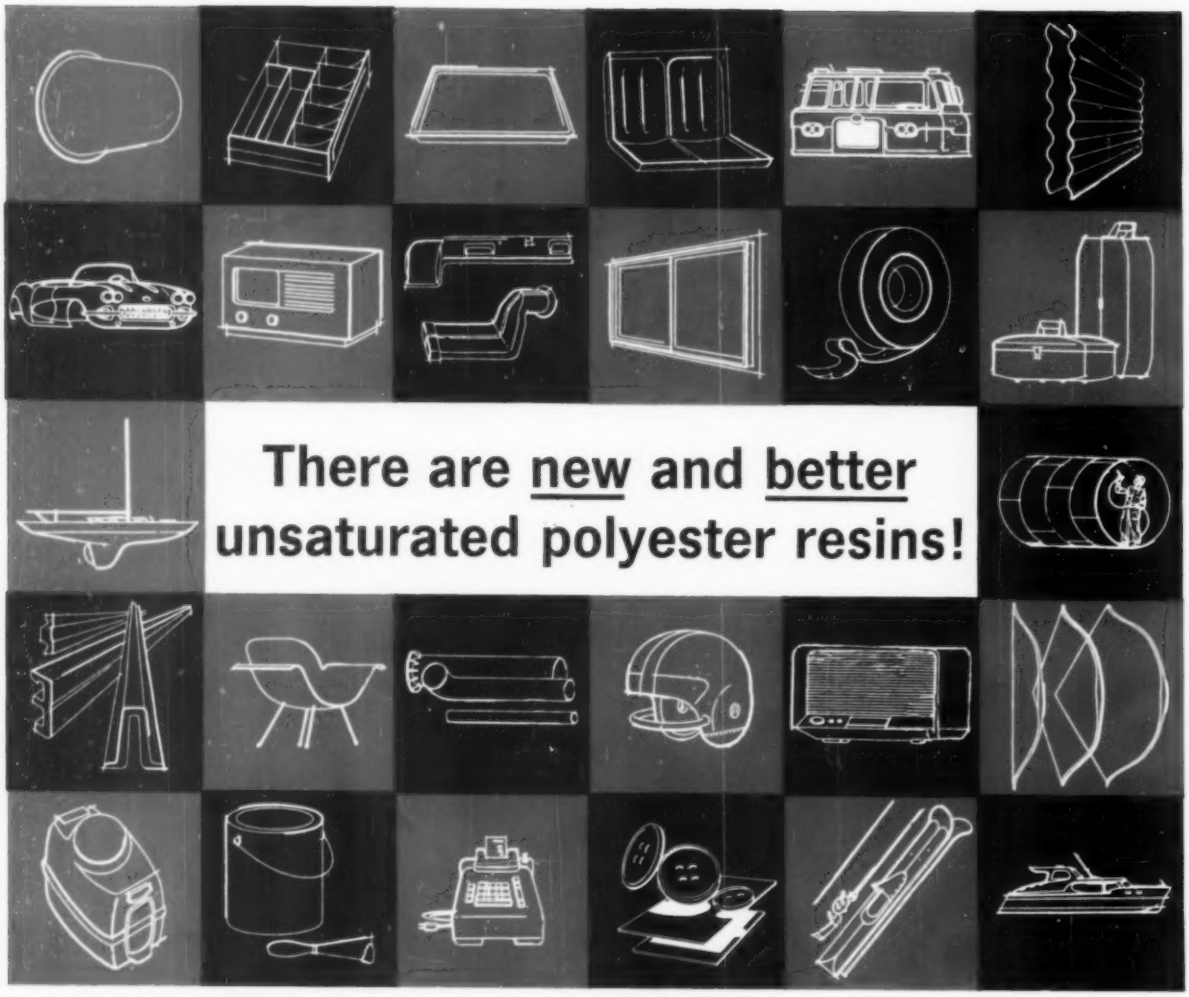
Serving many of the leading companies in the field of decorated laminates, Decotone works closely with leading designers and decorators whose style-worthy designs Decotone artisans reproduce with utmost fidelity by multi-color gravure printing.

Write for complete information about Decotone Decorated Laminating Paper, produced under a single responsibility from the pulp to the decorated paper ready for laminating.

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Ask Oronite for isophthalic polyester resin formulations and samples. Possibly Oronite has a suggested formulation that will perform better in the products you market, or intend to market.

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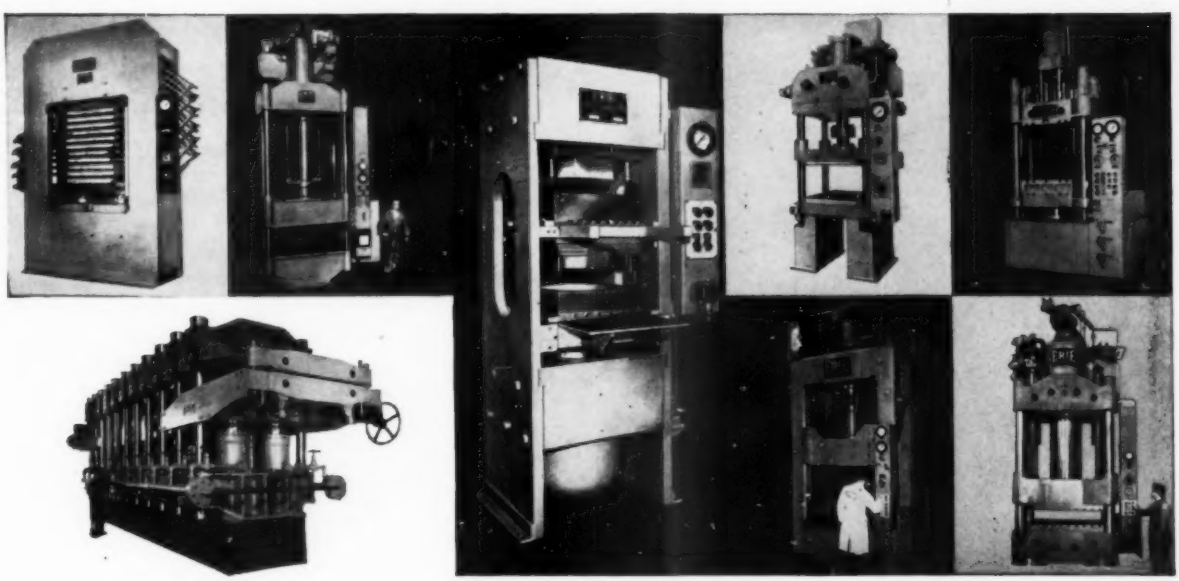
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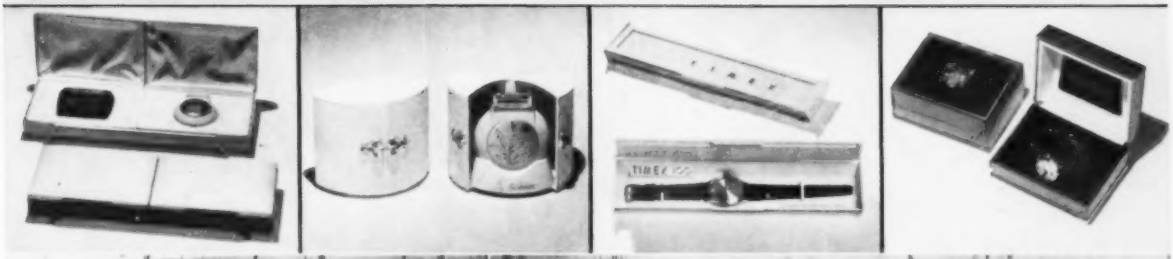
for metal-to-plastic assemblies... decorative or functional

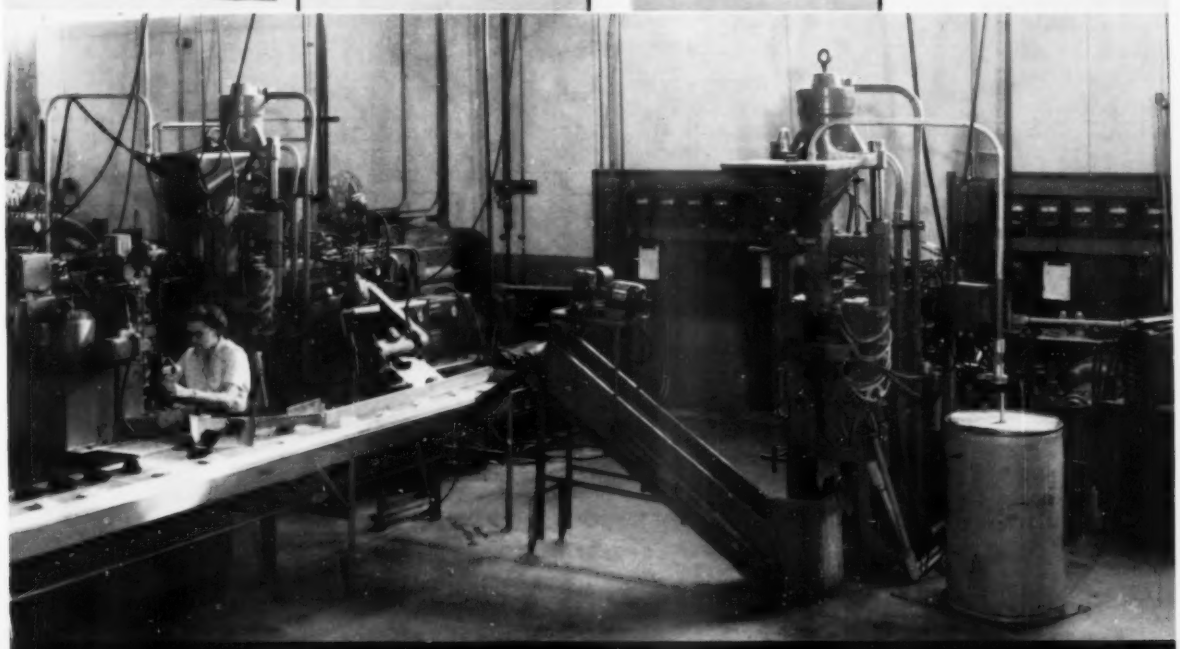
National Lock Company specializes in manufacturing metal-to-plastic assemblies . . . ALL FROM ONE SOURCE. Complete production, finishing and plating facilities are available for decorative and functional overlays, inlays and inserts. These, plus National Lock's compression and injection plastic molding equipment, make the finished product. Contact us when your "specs" call for plastic or metal components, standard or custom. Our design engineers will help you solve your plastic product problems.

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Mr. L. H. Woolley, vice president of Farrington's Packaging Division, comments about their Lesters: "We are enthusiastic and delighted with them and they have been responsible for keeping Farrington the leader in display packaging."

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There is a Lester to meet your molding needs: Write for information.

For a new slant on one problem of injection molding, write for your FREE copy of "Tom Swiftly and his Timed Machines."



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HOW FMC SERVES THE CHEMICAL INDUSTRY

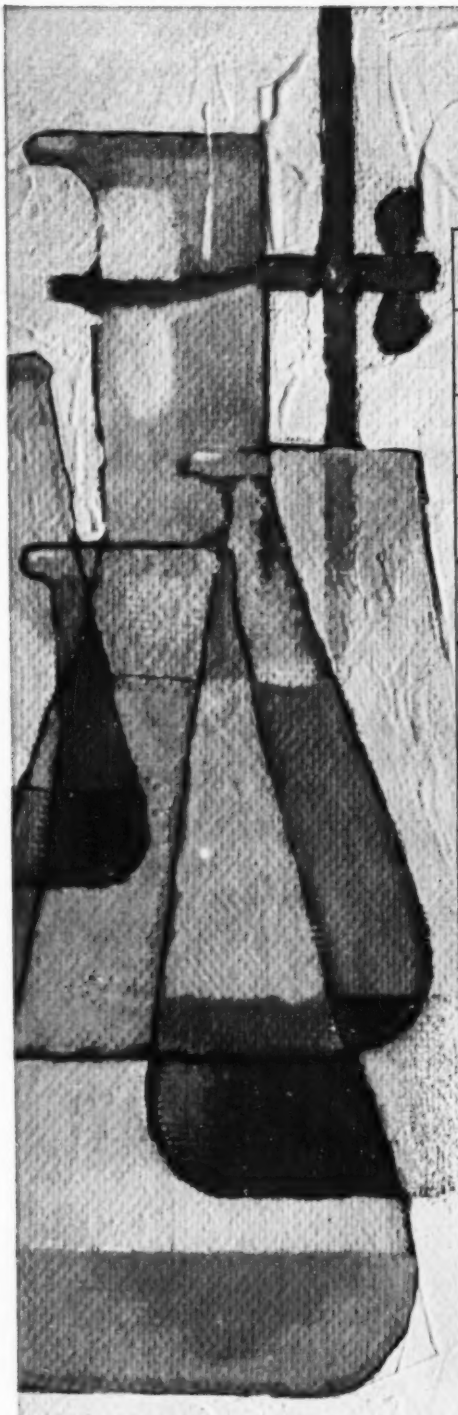
During the past decade, FMC has become one of the most progressive producers of basic chemicals for industry, agriculture, and national defense. Shown on the right are FMC's operations that serve the chemical industry. Producing organic and inorganic chemicals, as well as a variety of machinery products, these divisions represent a balanced network of processing plants, and raw materials and production facilities.

In addition, FMC is a principal factor in the petrochemical field through joint ownership of Petro-Tex Chemical Corporation, major producer of butadiene, butene, butylene, isobutylene, diisobutylene, triisobutylene, and alkylate.

Our company's dynamic progress as a supplier of basic chemical materials for industry and agriculture has resulted from aggressive programs directed at continual expansion and modernization of research and production facilities, together with development of strategic raw materials sources.

Progress of this sort highlights FMC's policy of planned diversification in three primary fields: **Basic Chemicals, Industrial and Agricultural Machinery, and Military Defense Materiel.**

For complete listing of our products and services, contact FMC, Dept. PRA, Box 760, San Jose, California.



BECCO	**Becco Chemical Division:** Peroxygen chemicals including hydrogen peroxide, peracetic acid, persulfates, sodium perborate
fmc	**Chemicals and Plastics Division:** Organic chemicals, plasticizers, plastics, allylic and epoxy resins and chemicals
Fairfield	**Fairfield Chemicals:** Basic chemicals for formulators of household and commercial pesticides
Niagara	**Niagara Chemical Division:** Insecticides and fungicides; weed killers; industrial sulphurs
Westvaco	**Westvaco Chlor-Alkali Division:** Alkalis, chlorine, chlorinated solvents, carbon bisulfide, soda ash
Westvaco	**Westvaco Mineral Products Division:** Sodium and potassium phosphates, phosphoric acid, barium and magnesium chemicals, sodium sulfide
Chicago	**Chicago Pump Company:** Sewage and industrial waste treatment equipment
fmc	**FMC Packaging Machinery Division:** Filling, packaging, and paper box machinery; bag makers; wrapping machines; paper and film converting equipment
John Bean	**John Bean Division:** Industrial high-pressure reciprocating pumps
Peerless Pumps	**Peerless Pump Division:** Complete lines of centrifugal pumps for CPI
fmc	**Packing Equipment Division:** Drum and case automatic handling and warehousing systems
Petro-Tex	**Petro-Tex Chemical Corp.:** Butadiene, Butene-1, Butene-2, Butylene, isobutylene, diisobutylene, triisobutylene, alkylate *50% owned by FMC and Tennessee Gas Transmission Co.

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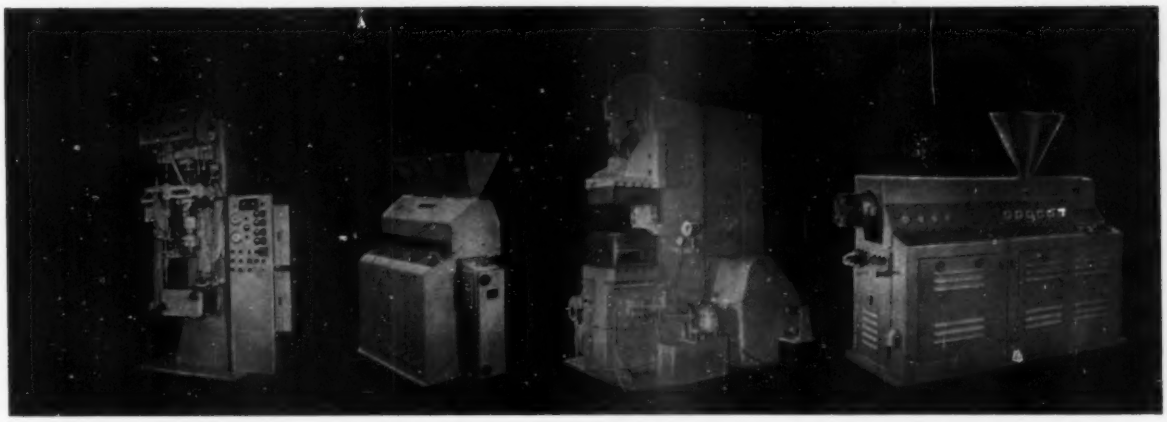
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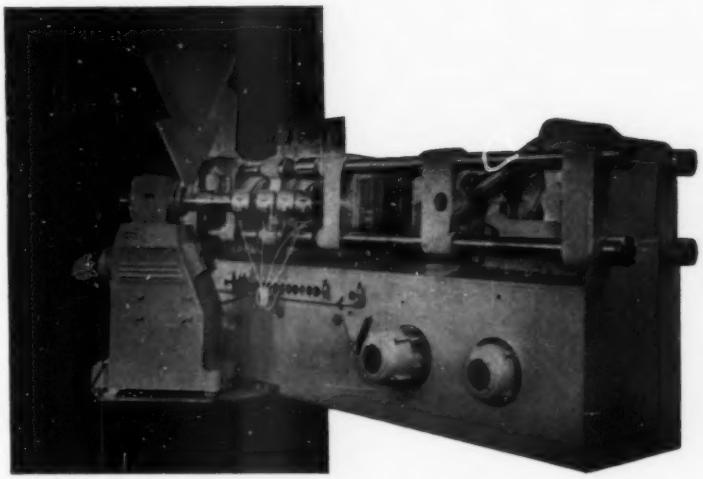
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OVERSEAS AGENTS THROUGHOUT THE WORLD

U.S.I. POLYETHYLENE NEWS

A series for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

JANUARY, 1960 U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

Throw-away Polyethylene Pillow Covers are now being manufactured for use in hospitals.

The strong, lightweight, polyethylene



Disposable polyethylene pillow covers for hospital use are convenient, easy to handle, help prevent cross infection.

covers are easy to handle... are disposed of when the cover is changed. The Manufacturer reports the pillow slips reduce danger of cross infection, eliminate autoclaving and help avoid waste. In addition, the slips may be used as disposable containers for contaminated objects. The manufacturer packages the product in pop-up dispensers containing 500 covers.

Polyethylene Bag-in-Box Packaging has significantly lowered shipping costs and improved the efficiency of a mid-western creamery.

The company reports it now ships 50 to 55-lb. containers of dairy products in 3-mil polyethylene bags packed in corrugated cartons in place of previously used returnable 10-gal. cans. Use of polyethylene helped cut shipping and maintenance costs by 17%, and saved valuable storage space necessary for the metal cans.

Further benefits are: greater control over package weight, shelf-life of products is doubled, insect infestation is eliminated, and leakers are greatly reduced.

Bags are made from polyethylene tubing which are completely heat-sealed across top and bottom except for a 5-inch opening at one corner. The bags are filled through the opening which is then tied shut with tinned wire. A shipping line speed of 125 to 150 bag-in-box units per hour is reported.

Polyethylene Wins Awards In Packaging Competition

Packages consisting in whole or part of polyethylene won six of the top awards in the recent National Flexible Packaging Association competition. Awards were presented during the fall meeting of the NFPA at White Sulphur Springs, West Virginia.

First prize in the "Break-Through" category went to a food concern for a polyethylene-coated bag for a line of fruit-flavored "icicles". Among the other winners using polyethylene as a film, laminate, or coating were bags for: water softener, hybrid corn seed, potatoes, marshmallows, and a polyethylene wrapping for bread.

U.S.I. Forms International Company To Serve Polyethylene Markets Overseas

New Unit Will Provide Technical Service, Sales, and Market Information

A new European company has been formed by U.S.I. to handle the overseas sales of PETROTHENE polyethylene resins and to provide technical service to customers and help in developing markets for polyethylene products. The new unit will be called U. S. Industrial Chemicals Company-International, Division of Sales and Development Company of National



Howard W. Woodham



Kenneth E. Cosslett

Distillers and Chemical Corporation (International) S. A., located at Kirchenstrasse 13, Zug, Switzerland. Operations of the new subsidiary began during October of 1959.

Well Equipped Facilities

A customer service laboratory will be an integral part of the new company. It will be completely equipped with processing and test equipment designed to meet European standards and operating conditions. The laboratory will be used to demonstrate processing techniques and for research and evaluation studies to help its customers develop new end-use markets and produce improved products. The laboratory will also include polymer testing equipment to insure product quality. The laboratory will service markets in the European countries, including the United Kingdom. Howard W. Woodham is the Manager of the new Technical Service Laboratory.

To Back Up Local Agents

Sales Manager of U.S.I.-International is Kenneth E. Cosslett, who has been U.S.I.'s Assistant Export Manager. According to Mr. Cosslett, U.S.I.-International's PETROTHENE resin sales will be made through its established representatives in European countries. The new company will be a supporting unit to help these representatives provide the close technical assistance which the polyethylene market demands.

Nuclear Reactors Use Polyethylene Plate

Polyethylene plate is used in nuclear reactors as a replacement for concrete in areas where weight and space limitations are of primary importance. Polyethylene plate exhibits excellent neutron-shielding capacity and is widely used for neutron-shielding protection on nuclear reactors.

Automatic equipment for uninterrupted extrusion of polyethylene plate is now producing 48-by-96-inch sheets of the plate at a rate of 6,000,000 pounds per year. It is extruded in thicknesses up to 1⅛ inches from PETROTHENE 100 resins in both natural and specially compounded forms.

Critical properties of the polyethylene plate produced by the continuous extrusion process are reported to be equal to or exceed those of plating produced by compression molding methods. The chief advantages of forming polyethylene plate by extrusion are a high rate of production and guaranteed freedom from voids.

Duck Hunters Use Polyethylene Film

Duck "ponds" of polyethylene film are being used by a number of hunters throughout the country.



Photo courtesy True, The Man's Magazine

The novel man-made "ponds" are built by spreading polyethylene film in fields where ducks feed on their southward journey each fall. The sun's rays reflect from the polyethylene film which appears to be open water in a frozen field. A spread of decoys further heightens the illusion.

Hunters say by the time ducks realize their mistake, it's usually too late!

DO YOU HAVE a new polyethylene packaging development you'd like the industry to know about? Make it routine to send your information on new developments to U.S.I. POLYETHYLENE NEWS.

Address the Editor,
U.S.I. POLYETHYLENE NEWS, U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corp., 99 Park Avenue, New York 16, N.Y.

U.S.I.

Vol. V, No. 1

POLYETHYLENE PROCESSING TIPS

CONTROL STOCK TEMPERATURE TO IMPROVE FILM PROPERTIES

Polymer or "stock" temperature is one of the most important variables in extruding polyethylene. Fluctuating polymer temperatures can cause undesirable variations in film properties and operating conditions.

With blown film, for example, poor temperature control may result in such film defects as non-uniform gauge, width fluctuation, variable optical properties, wrinkles in the finished roll, pinholes, and bubble rupture or collapse during extrusion.

Determining Optimum Temperature

The effect of stock temperature on three important film properties – haze, gloss and transparency – is shown in the accompanying graph. Within the temperature range necessary to maintain a bubble, increasing stock temperature results in improved optical properties. The optimum stock temperature, from an optical standpoint is, therefore, the maximum temperature at which a uniform bubble can be maintained.

When the optimum stock temperature is determined for a particular set of conditions, it must be held constant. Any lowering will cause deterioration in optical properties, and any increase will result in poor bubble control and eventually in bubble collapse.

How the Resin Is Heated

Stock temperature is maintained by two heat sources:

1. Uncontrolled heat produced by the action of pressure and friction within the extruder barrel. This is the primary heat source.
2. Controlled heat supplied generally by an external electrical heating system. This is the secondary heat supply.

The electrical heating system used in most extrusion operations consists of a heat source (resistance heaters), a number of thermocouples to sense the temperature of the barrel wall, and temperature-indicating devices such as deflection-type galvanometers or potentiometers. The potentiometer, which measures the voltage supplied to the heater, is more sensitive than the galvanometer, which measures the current passing through the resistance wire. However, since galvanometers are less expensive, they are in more common use.

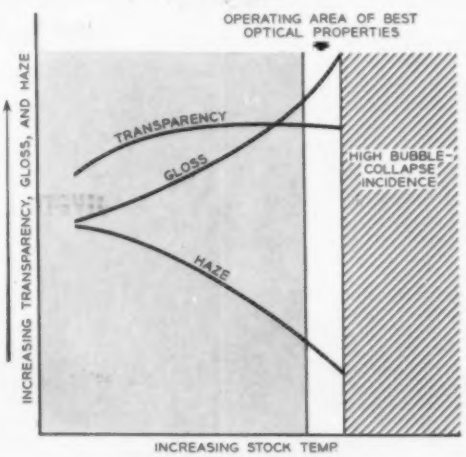
Controlling Temperature

Heaters should fit snugly against the barrel surfaces to insure good heat transfer. Loose heaters will result in loss of heat as well as uneven heating.

When a thermocouple needs changing, it is important to replace it with one of the same length and composition. Galvanometer-type temperature indicators are calibrated for a specific amount of external resistance, including that of the thermocouple. If a thermocouple of different lead length and composition is used as a replacement, the galvanometer must be re-calibrated accordingly.

The primary heat produced by action within the extruder barrel increases with operating time. This is the result of screen pack contamination, with attendant build-up of pressure and friction.

Unless this additional heat is compensated for, stock temperatures will rise although the thermocouple and galvanometer settings are unchanged. The external heating controls do not respond because the temperature of the wall measured by the thermocouple differs from the actual temperature of the resin melt itself. However, lowering the thermocouple settings will reduce the heat input from the external heaters and will tend to offset this additional internal heat and keep stock temperature constant.



Accurate Melt Temperature

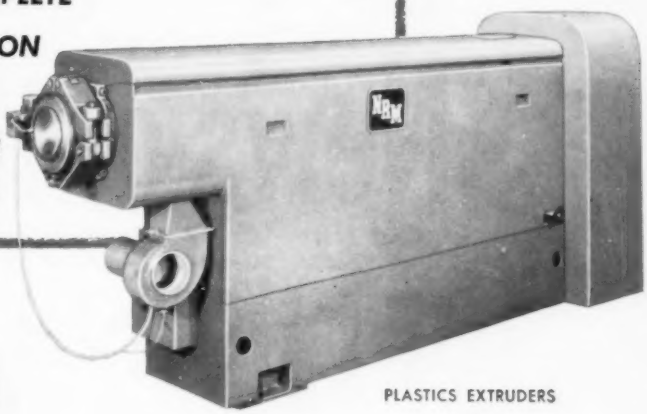
The operator can obtain a better indication of actual melt temperature by means of a thermocouple which extends through the die or collar wall into the melt stream. He can also attach a simple pressure gauge to the extruder barrel (see U.S.I. Polyethylene Processing Tips, Vol. IV, No. 5). This gives a constant check on internal pressures affecting polymer temperature.

For good temperature control it is necessary to recognize a difference between actual stock temperature and measured temperature; this temperature difference increases as pressure goes up. Using experience as a guide, the operator can make periodic adjustments of control temperature to keep actual polymer temperature constant.

The effect of stock temperature on film properties is vital, and a variety of problems may turn up in connection with efforts to keep the optimum temperature constant. We, therefore, invite you to ask for the cooperation of U.S.I. Technical Service Engineers whenever control problems arise.

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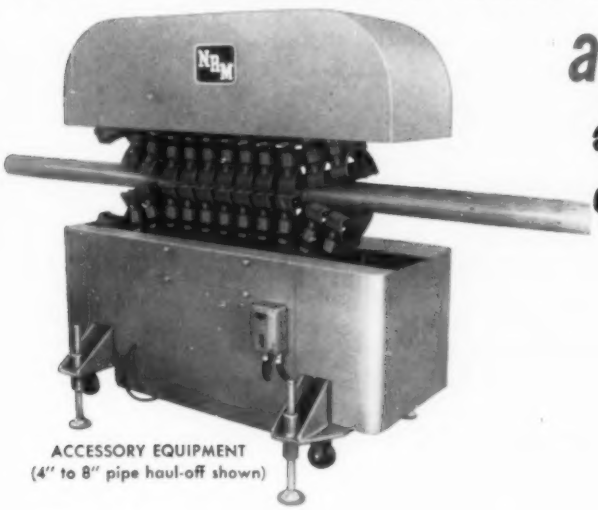


PLASTICS EXTRUDERS

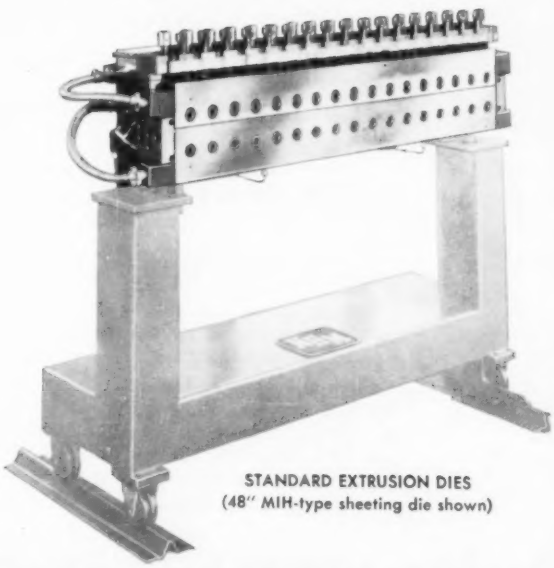
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assure high production rates . . .
economical operation . . . long life



ACCESSORY EQUIPMENT
(4" to 8" pipe haul-off shown)



STANDARD EXTRUSION DIES
(48" MIH-type sheeting die shown)

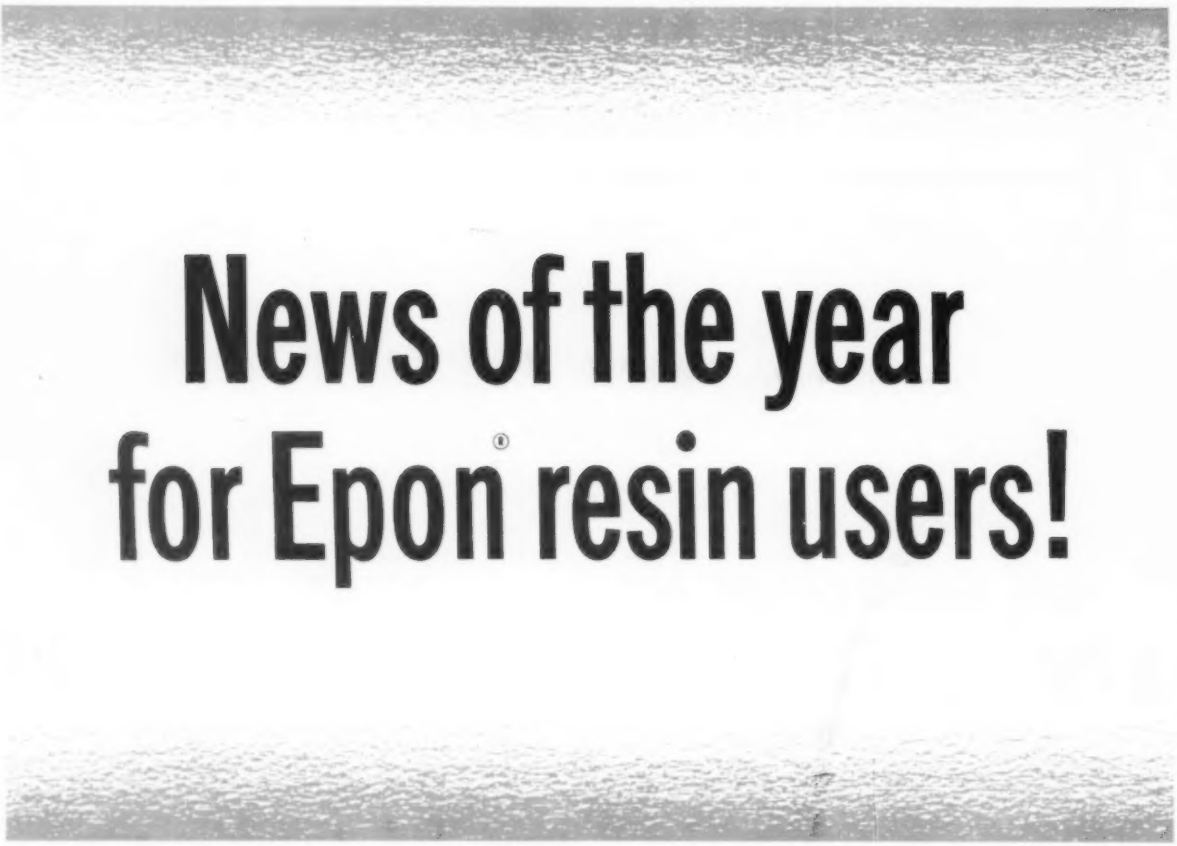
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- **100% Epon resin solids application**
- **15 mils thick—one coat**
- **Conventional spray equipment**

Use your present equipment to spray 100% resin solids in applications of up to 15 mils thick on a flat or vertical surface! Sounds impossible? It was . . . until Shell Chemical developed two new Epon resin curing agents, H-1 and H-2.

Curing agents H-1 and H-2 assure unusual working pot life while retaining all the many desirable film properties of Epon resin. Humidity does not adversely affect the performance of formulations using H-1 and H-2 . . . in fact, a small amount of moisture is actually desirable. This "revolution in surface coating techniques" means that you can apply heavy coats of tough, durable, corrosion-resistant Epon resin as easily as you now apply a coating containing solvents. That's *really* big news!

GET IN ON THE GROUND FLOOR of this important new development by contacting your nearest Shell Chemical district office right now. Write or phone the one nearest you. Ask for complete information on Epon resin curing agents H-1 and H-2.

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PLASTICS AND RESINS DIVISION

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IN CANADA: Chemical Division, Shell Oil Company of Canada, Limited, Toronto

SHELL

THE PLASTISCOPE*

News and interpretations of the news — By R. L. Van Boskirk

Section 1 — **January 1960**

Price decline for polyethylene. Union Carbide has reduced the price of all polyethylene formulations under 0.940 density by 2½¢/lb., which makes the base price for general purpose or film grade resin 32½ cents. Other companies quickly followed this move.

The price cut was a mild surprise in that it came a little earlier than expected. The reason given was to meet competition from discounts given by some other resin producers. Why the word "discount" was used instead of a straight reduction is not known. Sometimes it is used as a hint to customers that they might use the discount to improve their profit picture when competition is disruptive without lowering the price of their finished product. Theoretically, a discount from list price without qualifications means there is a probability that at some time it may be withdrawn and list price restored but that event almost never happens. For all practical purposes the base list price of polyethylene is now 32½ cents.

Speculation on other reasons for the price cut are many and varied. One is that Union Carbide as the leading volume producer in the industry intends to maintain its position not only by expansion but by serving notice that the customer may expect to receive first benefits of a price reduction from that company. In other words Union Carbide wouldn't enjoy having other companies first in the field with price reductions. And furthermore, there is always a possibility that a price reduction will help to discourage possible new producers from entering the field.

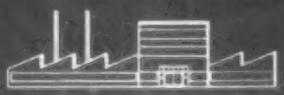
Profits in high-pressure polyethylene are thought to have been quite satisfactory by observers who point out that the difference between cost of monomer and polymer is of a sufficient margin to permit substantial reductions now that the industry has reached a billion lb. volume. The older companies have also had sufficient time for amortization although it is probable that they are plowing back a large portion of such savings into new plants.

The chaotic price situation in polyethylene film is also offered by some producers as a reason for the abrupt price cut in resin. One man facetiously says that the list price of film is: "We'll meet any price." The competition for film customers is almost ferocious and even contributed (along with heavy inventory buying in early 1959 and the steel strike) to a lesser sales volume of film in the last half of 1959 than in the first half because converters were waiting to see what would happen. The opinion of various participants in the struggle is that the 2½¢ reduction in resin could help the film producers develop a better profit situation if they will hold the line on film prices and call off what amounts to a price war.

A new type of transistor. A plastic transistor as good as those made from germanium has been developed by Nikolai Semenov, famous Russian scientist, according to a recent press release. The material, polyacrylonitrile, was bombarded by radioactive matter and "became as electrically conductive as (To page 43)

*Reg. U. S. Pat. Off.

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THE PLASTISCOPE

(*Continued from page 41*)

germanium and silicon" according to Tass, Russian news agency. It is less costly and can be more easily processed than germanium which is extremely high cost and generally obtained in minute quantity from smokestacks. Acrylonitrile has been polymerized in the United States but is so insoluble and infusible as to be practically useless. It is often used as a copolymer with other materials such as vinyl or styrene.

Russian influence on plastics. If the above report is true it indicates that extensive Russian research in plastics is paying off and recalls the sight of some Russians as well as Poles and Yugoslavs in attendance at the Dusseldorf Exposition.

It is reported that these representatives of countries behind the Iron Curtain purchased considerable amounts and varieties of equipment at the Show; most of it is said to have been of German and Italian manufacture, although some French machinery is also said to have been involved.

Europeans apparently have no fear that the Russians will copy their machines—say they will always stay ahead in technical advancement—that equipment sold now will soon be obsolete anyhow.

Americans have for the most part remained aloof from this market—assert that it is difficult to deal with one purchaser who represents the state and that the Russians have no regard for patents or licenses. Meanwhile the Russians struggle to make an impact in the Western hemisphere continues at a high level of intensity. There was the trade fair in the United States last summer—another in Mexico, and Brazil sends a mission to Russia to study the possibility of trading raw material for Russian-made equipment. A 7-man Russian team recently made a tour of the United States to study plastics in the building industry.

Manufacturing Chemists' Assn. viewpoint. Once in a while a mistaken opinion is expressed that MCA is opposed to trade with Russia. Such is not the case at all. MCA encourages interchange of chemicals between the U. S. and other countries. An International Operations Committee has been organized by MCA to help with the foreign operations engaged in by 50% of their members and which accounted for 15% of their 1959 capital outlay. The overseas operations are said to offer opportunities to break into tariff protected markets, create outlets for raw materials in the U. S., and create sources of materials in short supply in this country. As noted above, U. S. chemical companies have vast investments in other foreign countries, much of which is for the production of plastics material which not only takes care of the tariff situation in each of those countries but is also a guardian against future invasion of those countries by Russian plastics, should the latter ever become a world-wide exporter of such materials.

The erroneous opinion that MCA opposes dealing with Russia probably comes from a report that members of the Association flatly refused orders totaling a $100 million for their group, plus orders for equipment, because the Russians wanted to balance it with credit for purchases for them. MCA's stand on this point is that plants and know-how should not be sold to Russia to give them technical knowledge to build up military strength and wage economic warfare against the West. Every man-hour of chemical re- (**To page 45**)

where quality is a matter of life or death

In the manufacture of medical tubing there is no margin for error . . . human lives hang in the balance. That is why manufacturers of medical tubing and apparatus have adopted VYGEN 120 . . . the quality PVC resin that satisfies the rigid government specifications. VYGEN 120 is not just another quality resin, but one of a family of specialized resins developed and manufactured to meet the requirements of the processor and the demands of the end product. No matter what your processing requirement, you should look to the VYGEN family of PVC resins just right for every application. For complete information call or write us today!

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THE PLASTISCOPE

(*Continued from page 43*)

search which the Soviets would save would mean a man-hour which could be applied to other aspects of its scientific progress. Chemical know-how and orders would give the Soviet Union a technical short-cut far more valuable than the commodities involved, said an MCA spokesman.

Further note on foreign trade. According to a good source in the industry, vinyl film raincoats made in Hong Kong from film produced in Japan are so low cost that several American raincoat manufacturers have cut their domestic production and are actually distributing the foreign-made coats in this country. A similar trend is under way in baby pants and in some types of vinyl footwear such as rain boots and sandals. Inflatable toys are another big item on the import list. This is another pretty little problem in foreign trade—imports of vinyl resin have slowed down to almost a walk but finished products produced from low-cost foreign-made resin are increasing steadily. This is a trade problem that has been wrangled over by politicians, manufacturers, farmers, and consumers in the U. S. for over 75 years. Every decade there is a new angle but fundamentally the problem is the same. It's probable that no solution will be found in the lifetime of present man. The only thing to do apparently is to learn to live with it.

Celanese buys bottle plant—expands resin production. Royal Manufacturing Co., one of the largest and earliest blow-molded polyethylene bottle producers has been acquired by Celanese Corp., producers of low-pressure polyethylene and other plastics materials. Expansion of Royal's plants in Prescott, Ariz. and Chicago, plus operation of a new plant on the East Coast will start immediately. Royal will be operated under its present management.

Low-pressure, high-density PE has been found particularly adaptable to production of bottles for detergents—is expected to account for 80% of light-duty liquid detergent containers soon, according to C. C. Coates, founder and president of Royal.

The next question is will other producers of high-density resin follow the Celanese example and thus integrate the blow molding industry similar to what has been happening in film?

Celanese has also announced expansion of its 40 million lb. low-pressure process resin plant in Houston to 50 million lb. a year.

Reichhold continues expansion. A new 60 million lb. capacity phthalic anhydride plant at Newark, Ohio, by Reichhold Chemicals Inc., is scheduled for production in late 1961. The company will then have four plants in the U. S. The others are in Detroit, Azusa, Calif., and Elizabeth, N. J. Reichhold apparently aims to see that there are no more shortages in phthalic such as that which hit the alkyd, plasticizer, and polyester industries last summer.

Reichhold has also just introduced a new dry type adhesive—a phenolic resin supported by a paper film which eliminates the need for glue-spreading equipment. It will be used in bonding exterior and marine plywood, veneers, overlays, thin metal sheets, honeycombs and in lamination of heavy beams. It is claimed to be unlike previous film-supported (To page 47)

New ideas in **NYLON**





This new MōPar fuel filter featuring a molded Spencer Nylon housing is now installed in 8-cylinder Chrysler Corporation automobiles for 1960. Shown above are the 1960 Plymouth and Imperial.

New Advance in Precision Automotive Parts . . .

Chrysler Introduces New Fuel Filter With Molded Spencer Nylon Housing:

Marking another major advance in precision automotive parts, Chrysler Corporation is now installing a new MōPar fuel filter with a molded Spencer Nylon 404 housing in its 8-cylinder automobiles for 1960. The filter is currently being supplied to Chrysler by the Fram Corp.

Representing one of the toughest automotive uses yet assigned to a plastic, the new MōPar fuel filter was subjected to several torturous tests before it was accepted by Chrysler Corporation. Tests like these:

For more than 1,000 hours, the fuel filter quivered on a special machine to gauge its ability to withstand vibrations over the entire frequency spectrum.

To test the heat-cold resistance of the new filter, it was "baked" for 24 hours at 250° F. Then it was "frozen" at —40° F. for an additional 24 hours.

Oil heated to 140° F. was poured through the filter's Spencer Nylon housing to determine its resistance to greases.

And there were other excruciating tests. But throughout them all, the Spencer Nylon housing proved to have excellent heat stability, impact strength and resistance to hydrocarbons and corrosion. Spencer Nylon has also shown superior moldability and sealability.

As a leader in the development of nylon for automobiles, jet airliners and other products, Spencer Chemical Company has the experience and personnel that can help you put nylon to work in your products.

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THE PLASTISCOPE

(*Continued from page 45*)

adhesives in that it is fast-curing, economical, and tolerates more variation in moisture content of materials to be joined.

The company has also raised the price of phenolic water soluble thermal insulation resins which are used as binder for glass fiber and rockwool insulation from ¼¢ to ½¢ a pound.

New low-pressure polyethylene plant. Goodrich-Gulf Chemicals will build a new plant to produce Ziegler type high density polyethylene at Port Neches, Texas. The announcement says the plant will produce oriented polyolefins of a high-density type not now manufactured in the U. S. and will be complete in late 1960. Specific characteristics, including resistance to environmental stress cracking and heat, will be built into the new product which is designed to be particularly suitable for bottles, pipe, and wire insulation.

Goodrich was one of the first companies to obtain a license from Ziegler, but has spent the last four years in pilot plant operation in developing what they believe will be a superior grade resin for the above mentioned applications. Developmental work has covered all polyolefins with emphasis on polymers of ethylene, propylene, and butylene.

Activities in polypropylene. Commercial production of Olefane polypropylene film from its 10 million lb. capacity plant at New Castle, Del., has been announced by AviSun Corp. Film will be produced from one through four mils thick and sheets from four to 20 mil thickness for thermoforming. The company will use resin produced at its 20 million lb. plant at Port Reading, N. J.

Olefane is offered in rolls from 2½ in. to 60 in. wide, can be untreated or treated for printing and can be either low slip or high slip. The new material is claimed to give the greatest area coverage per lb. of any film.

Another polypropylene development is Texas Eastman's announcement that its new production unit at Longview, Texas will have a designed capacity of 20 million lb., and will use a process developed by Eastman. Production is scheduled to begin in late 1960 with full volume expected in mid-1961. Limited commercial production started last September and output from that operation will continue to be available in small quantities until the new plant is fully operative.

Polybutene for plastics. Polybutene-1 may soon be entering the plastics arena, according to Dr. L. M. Welch of Petro-Tex Chemical Corp., in a paper presented at an American Chemical Society meeting. It will be a material designed for heavy duty such as piping and film that must stand up under abuse. It belongs to the same family as polyethylene and cost would be about the same. Test samples were said to have better tensile, tear, and impact strength.

Another kinfolk to the above, mentioned at the same meeting by J. R. Haws of the Phillips Petroleum Co., is high-trans polybutadiene. This, strictly speaking, is actually a rubber, but it can double as a plastic material, since it can be milled, extruded, melted, and molded.

For additional and more detailed news see Section 2, starting on p. 234

LETTERS TO MODERN PLASTICS

Where readers may voice their opinions on any phase of the plastics industries. The editors take no responsibility for opinions expressed.

Good, not fair

Sir: We note on "Modern Plastics Chart of Self-Extinguishing Plastics Materials," pages 91-98, in the November, 1959, issue of MODERN PLASTICS, under "Resins and Molding Compounds," that the light stability of the Diamond Alkali Co. resins is listed as "Fair." At the time we submitted information on our materials for inclusion in the above chart, our comment on light stability was: "Darkens on prolonged exposure to light." Certainly we do not interpret this statement to be "Fair" light stability. On a scale "Excellent, Good, Fair," our PVC materials, light stability should at least be classified as "Good"—definitely comparable to other polyvinyl chloride materials, not inferior to them.

Perhaps our selection of words in classifying our materials was in error, but in attempting to give a true picture of the light stability behavior of polyvinyl chlorides we feel we should not be penalized through interpretation. It is unfortunate we have made this error and in future requests for information perhaps we should attempt to anticipate the interpretation to avoid embarrassment.

G. J. Koch, Manager
Technical Service
Diamond Alkali Co.
Plastics Div.
Cleveland, Ohio

Qualitative terms are frequently sources of trouble, and we are happy to help correct a possible misinterpretation . . . Incidentally, a supplementary chart, covering materials not listed in the original compilation, is scheduled for our next issue.—Ed.

Warehousing for the South

Sir: I have read with a great deal of interest your article of "Do you know your distributors?" and the article by Mr. Richard J. Jacob, "The next 10 years in distribution" (MPI, Oct. 1959, p. 81).

These articles particularly interested me because, before I retired from the Army, my specialty was logistics and supply, which included warehousing. I had been in command of supply depots, which afforded me a broad knowledge of new materials and articles coming into use for the Services.

To me the plastics industry appears to be about where the steel industry was about 70 years ago with an unlimited future.

I became so interested in plastics after my retirement from the Service, that I began a research concerning manufacture and distribution. I was surprised to note that there was only 4% of plastics materials and articles made in the South, especially since the South is experiencing such economic growth.

It would seem that plants now in operation would be interested in the establishment of a display and distribution center in the South to serve the South and Southeast. Such a center could serve as the manufacturers' warehouse at a considerable savings compared with cost of a congested area.

Such a center would become a super market for plastics. It would greatly aid the distributors, small plastics dealers, dealer-fabricators and mill supply houses. Needless to say, it would greatly increase the use of plastics in many ways. We would like to have the reaction of the industry to such a project.

A. C. Herzberg
A. C. Herzberg & Assocs.
Montgomery, Ala.

Of course, plastics materials are being distributed through lumberyards, sheet metal yards, building materials houses and vertical distributors such as flooring shops, boatyards, etc. One of the big points made in our recent articles on distribution was that training in the fabrication and use of plastics must accompany provision of warehouse availability—Ed.

Brazilian melamine panels

Sir: In MODERN PLASTICS for July 1958, p. 92, you published a nicely illustrated article on melamine hand-painted panels. You may be interested in knowing that for some time Brazil has had hand-painted panels made by several of our best-known painters. Some of these panels are 10 by 60 ft. and painted by José d'Avila, a Brazilian artist.

The conference room of our company is decorated with such a 10- by 24-ft. panel that was executed and pressed by us.

There is a trend here to consider melamine high-pressure laminates as a new material for artistic paintings, as a replacement for wood or canvas. The melamine protection, of course, preserves this artistic work for a long time. Because of this advantage, many modern buildings in Brazil have lobbies decorated with such an artistic melamine panel, especially those buildings which face the beaches. Other materials could not resist the humidity and salt water condition.

We don't wish to take away any merits from the U. S. high-pressure laminates industry and developments, but our factory was manufacturing artistic paintings before those referred to in your article. We even maintain a studio with free access to all artists who wish to paint, and we press their work without charge in order to further encourage progress in this technique.

A. Degens
Companhia Química Industrial
de Laminados
Rio de Janèiro, Brazil

Let's help the unions

Sir: Some time ago I read the editorial in the May 1959 issue of MODERN PLASTICS. I felt that industry publications would provide more information on plastics as a result. If that happened, it completely escaped my notice and explains the reason for this letter.

Our school programs for apprentices include related instruction and laboratory training on installations covering plastic laminates such as Textolite and Formica and 4- by 4-in. plastic wall tiles. These are the only items with which we have been seriously concerned. If there are others with practical application in the construction field, we would like to know of them. If so, we would like to do a proper job of teaching and training in those respects if manufacturers of such materials are interested in supplying their pertinent literature for use by our instructors and trainees.

Companies who wish to contact us will be welcomed and given a tour of our facilities so that they may ascertain at first hand if it would be of value to them to participate by assisting in furthering our education and training efforts.

Nicholas R. Loope, Dir.
Joint Carpentry Apprenticeship Committee of Washington, D. C. and Vicinity
Washington, D. C.

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BLOW MOLDING MACHINES

No patent problems!
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"SAVE HARMLESS" GUARANTEE



FULLY AUTOMATIC
complete with synchronized extruder

$15,000.00 (F.O.B. Germany)

- Price includes a fully paid, protected license under the above patents. No other machine seller can offer the same trouble-free patent structure.
- Kautex is the world's largest seller of blow molding equipment.
- 6 sizes (1/30 ounce to 50 gallons) with and without extruders.
- Up to 50 dry cycles per minute. (The fastest machine in the world).
- Single and double extrusions and low mold costs.
- Semi-automatic blow molder without extruder **$4,800.00**

SOME SALES AREAS AVAILABLE

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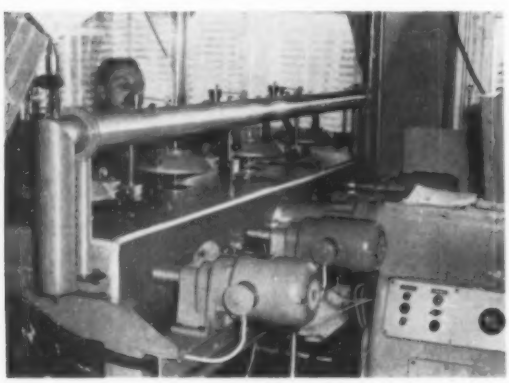
NEW MACHINERY-EQUIPMENT

Specifications, claims made, and prices appearing in these pages are those of the manufacturers or sellers of the machinery and equipment described, or their agents.*

Multiple-head extrusion unit

Extruders with large machines are often confronted with the problem of running small cross-section profiles at low extrusion rates. This may commit large equipment, representing a considerable investment, to a small production output, and reduce return on investment by the inefficient utilization of the extruder's capacity.

Designed to alleviate this situation and to maximize the profits on small size extruded parts, the Oerlikon VK1-4 extrusion set-up allows running four dies simultaneously from a single extruder. The output from one conventional extruder is fed to a double-wall, thermally insulated, internally heated, manifold. The manifold then channels the plasticated melt to four die stations each of which is equipped with its own metering pump which separately controls the actual output of each die. In this arrangement the conventional screw extruder is merely used as a plasticating and pumping device. Since only one screw extruder is now required to run four extrusion lines, machine utilization is maximized, resulting in lower capital costs per pound of output. Operating costs also go down since the number of operators per line can be generally reduced. In addition, less plant space is required. A complete set-up, consisting of a heavy-duty extruder, multiple-head distributor block, four extruder heads, metering pump drives, temperature control equipment, and appropriate take-off equipment can be supplied to meet customers' specs. Several basic types of interchangeable extruder heads are made which allow the extrudate to be taken off vertically upward or downward, or horizontally. Stations are positioned about 23½ in. apart. For small-diameter blown tubing, cooling rings specially designed for use with this extrusion head are supplied (including finger-tip control of cooling air). Contact rollers for checking tube diameters and a tube diameter scanner which regulates the blowing air to control the tube size are also a part of the system. Blown film take-offs have double roll winders for continuous production while changing spools. Accessory equipment for making gusseted or perforated tubing can also be supplied at extra cost. Complete set-ups for other small profiles and wire coating can also be supplied. Detailed **(To page 52)**



REAR VIEW of the Oerlikon VK1-4 multiple extrusion head; note drives for the four separate metering pumps, one at each die station.



ONE of the four extrusion stations on a set-up producing blown film showing the air cooling ring and diameter control equipment.



OVERALL VIEW of an Oerlikon VK1-4 complete extrusion plant for the production of blown film showing the overhead take-off equipment.

* Prices are deemed to be F.O.B. sellers' plants (unless otherwise stated), are for "standard" models, and are subject to change without notice. The publishers and editors of MODERN PLASTICS do not warrant and do not assume any responsibility whatsoever for the correctness of the same, or otherwise.

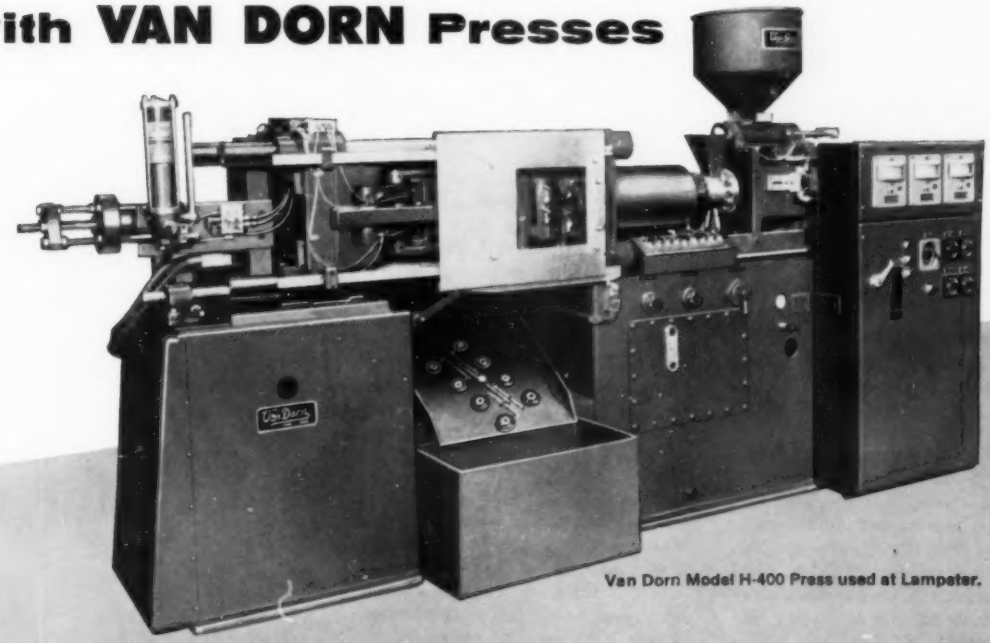


Hubley Tic Toy Clock—many of the 40 parts are made on The Lampeter Manufacturing Company's Van Dorns.

tic tock, 'round the clock

AUTOMATION

with VAN DORN Presses



Van Dorn Model H-400 Press used at Lampeter.

As a major supplier for The Hubley Manufacturing Company, a leading toy producer, The Lampeter Manufacturing Company is an extensive user of plastic machinery. Lampeter operates their fully automatic Van Dorn 4-6 oz. and Van Dorn 3 oz. presses *24 hours a day, six days per week.*

Besides a substantial reduction of cycle time, the company reports the Van Dorn presses are economical, versatile, and require minimum maintenance. The general manager says that if he buys more machines of the same size, Van Dorns would certainly be a top consideration.

You, too, can save time and money with Van Dorn high production injection presses. Write for detailed information.



Inspection of toy parts produced on the Van Dorn H-300.

Van Dorn

THE VAN DORN IRON WORKS CO.
2685 East 79th Street • Cleveland 4, Ohio

NEW MACHINERY-EQUIPMENT

(*From page 50*)

information on specific set-ups, the various sizes available, and sales terms can be obtained from the manufacturer. *Oerlikon Plastics Limited, Stans/N.W., Switzerland.*

Injection machine

Designed for high speed operation, the HPM Model 200-H-6/8A press has a newly designed heating chamber for improved plastication of material. Its one-piece torpedo construction permits the placement of heating bands directly on this section, providing an internal and external heated surface. Mold bases up to 15 by 26 in. can be mounted on platens which open to a maximum of 29 in. of daylight without the ejector box. Clamp is hydraulic with a capacity of 200 tons. Rated as a 6-oz. machine (8 oz. with prepacking), maximum injection shot is 10 cu. in. at a rate of 675 cu. in./min. and a maximum injection pressure of 20,000 p.s.i. Cycles range from 700 to 900/hr. Plasticating capacity is 90 lb./hr. The injection hydraulic system is independent of the clamp system and both can be controlled from the operator's station located in a cabinet placed in front of the machine; timing and temperature controls for the equipment are also located in that area. *The Hydraulic Press Manufacturing Co., A Division of Koehring Co., Mount Gilead, Ohio.*

Ejector sleeves

Seven standard diameters are now available from stock in total lengths of 4, 6, 8 and 10 in. with a bearing surface of 2¾ inches. Now moldmakers need not make their own ejector sleeves from solid ejector pins but can utilize the standard sleeves to make specific sizes by merely cutting the sleeves to length and relieving the inside diameter. The ejector sleeve heads are made of hot forged Nitralloy steel hardened to 70 to 80 on the Rockwell C scale and honed to minimize wear. Bearing diameters are finish reamed and honed and have a hardness of about 300 Brinell to allow relief with conventional equipment. *Detroit Mold Engineering, 6686 E. McNichols Rd., Detroit 12, Mich.*

Temperature control unit

The Autotherm mold temperature control unit is designed for single-temperature settings up to 240° F. and for cooling and heating. Elimination of a modulating valve and seals which will stand up to 500° F. results in a maintenance-free unit. All wiring is color coded, located in the front half of the machine, and easily accessible. The standard single unit is equipped with 9000-w. heaters, but is also available with 4500-w. units. Brass and copper piping is used throughout. Equipment has automatic shut off on low water conditions or lack of pressure; it features automatic filling and air bleeds, pressure regulation on incoming water supply, and fast response to both heating and cooling requirements. Units may be purchased in single, double, and triple arrangements. *Autotherm Inc., 1255 Kings Highway, Fairfield, Conn.* Sold by *The Rainville Co. Inc., 657 Franklin Ave., Garden City, N. Y.*



AUTOTHERM mold temperature control unit is designed for single-temperature settings up to 240° F.

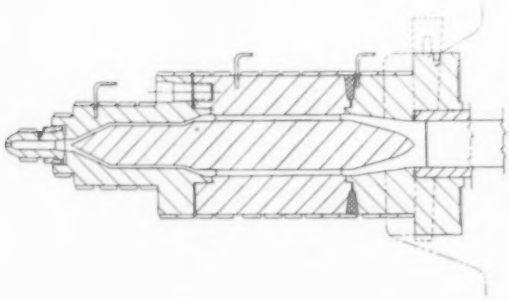
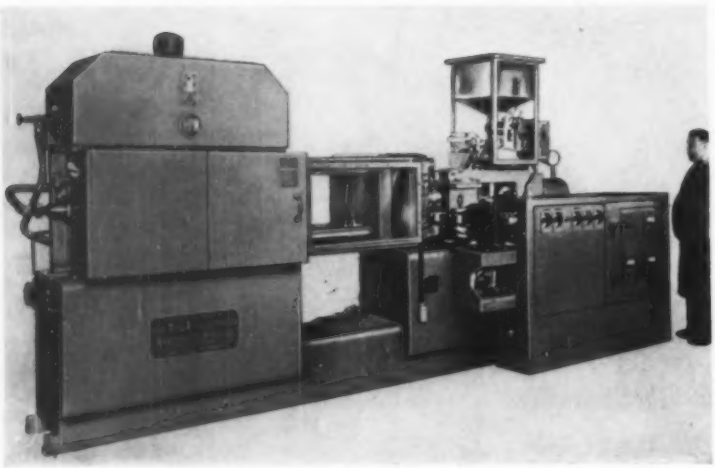
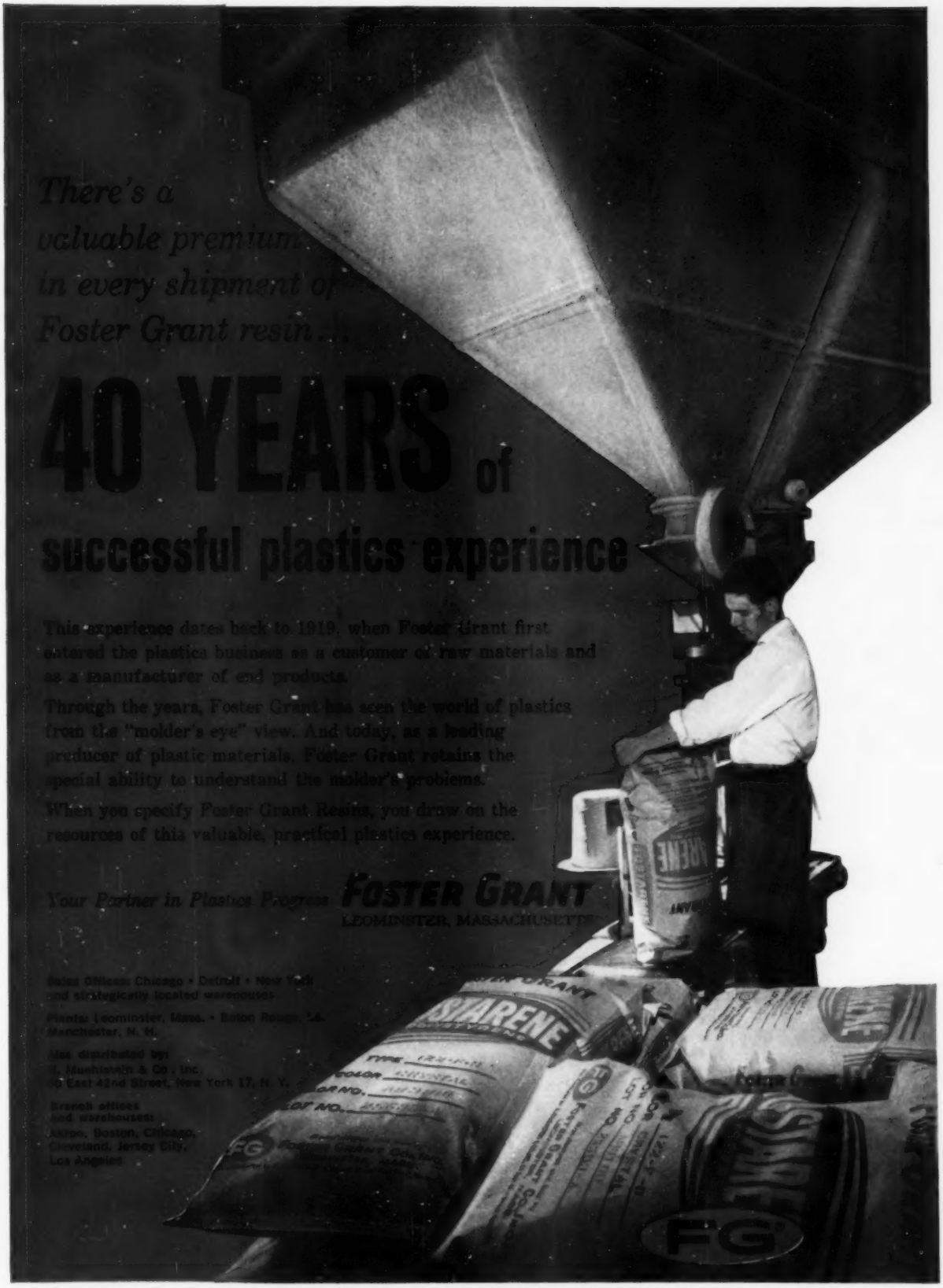


DIAGRAM of HPM's newly designed heating cylinder (left), which is used on its new model 200-H-6/8A injection press (see photo below).



Bag-molding accessory

Combination bleeder cloth and parting film called Ventcloth is now available for vacuum-bag molding operations. Consisting of a woven glass fabric impregnated with an efficient parting agent, the cloth is placed over the final plastic laminate layer just before the vacuum bag is used to cover the assembly. As vacuum is applied, air trapped under the bag surface escapes through the Ventcloth layer which remains porous through the entire cure, assuring that full atmospheric pressure is applied to all parts of the laminate. This increases resin flow as much as 15%, yielding a denser, more uniform laminate. The fine weave of the cloth produces a smooth **(To page 54)**



Manufacturers of Fostarene® Polystyrene • Fosta® Nylon • Fosta Tuf-Flex® Impact Polystyrene

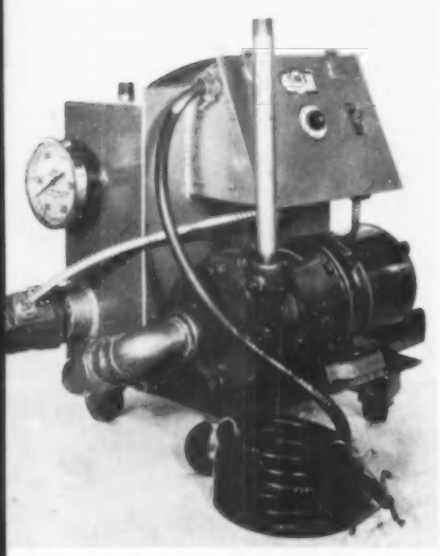
NEW MACHINERY-EQUIPMENT

(*From page 52*)

laminate surface that requires a minimum of finishing. *Narmco Resins & Coatings Co., 600 Victoria St., Costa Mesa, Calif.*

Mold-coolant circulator

A compact, low-cost, circulator for maintaining injection mold heats over a temperature range from 50 to 250° F. requires much less head space than earlier models, but has all parts easily acessible. All controls are protected by a heavy metal cover. A large easy-to-read thermometer provides a rapid check on the circulating-medium temperature. The unit is mounted on caster wheels and has built-in cooling. Price is $391.50 complete, and the item is stocked for immediate shipment. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*



IMS mold-coolant circulator maintains injection mold heats over temperature range from 50 to 250° F.

Die cutter

Twin die handlers on the Model 11327 Automatic Roller Die Cutter eliminate idle machine time. While one die handler is being loaded or unloaded, the other is cutting, doubling the production on one machine. Two different jobs can be die cut at one time, giving the cutter the utility of two machines. Also, one side can be down for die changes while the other remains in production. The equipment includes a vertical die handler which precompresses the stock and positions it firmly on the die while the roll passes over the die. With some materials, several plys may be die cut simultaneously. Die cutting area is 4300 sq. in. and each horizontal die handler has a usable area 50 in. wide and 45 in. deep. Minimum cycle is 10 seconds. Materials which can be cut include foams of urethane, polyethylene, and vinyl and vacuum formed sheets. *The Falls Engineering & Machine Co., 1734 Front St., Cuyahoga Falls, Ohio.*

Mask washer

Model W-7200 automatic high pressure mask washing machine will handle masks up to 72 in. long, 18 in. wide and 16 in. deep. Time and labor saving of up to 50% are possible over that required by manual cleaning. In many instances up to 20 coats of wet paint can be removed in 20 seconds. Cycle time is adjustable from 3 sec. to 20 minutes. A foot pedal is provided for opening and closing the non-ferrous splash-proof lid. A visual gage shows the fluid level in the 100-gal.-capacity tank. Intake strainers are provided on the pump. Self-cleaning filters are optional. The bulk of the contaminated solvent is discharged before sludge draining. *Conforming Matrix Corp., 364 Factories Building, Toledo 2, Ohio.*

Glass roving cutter

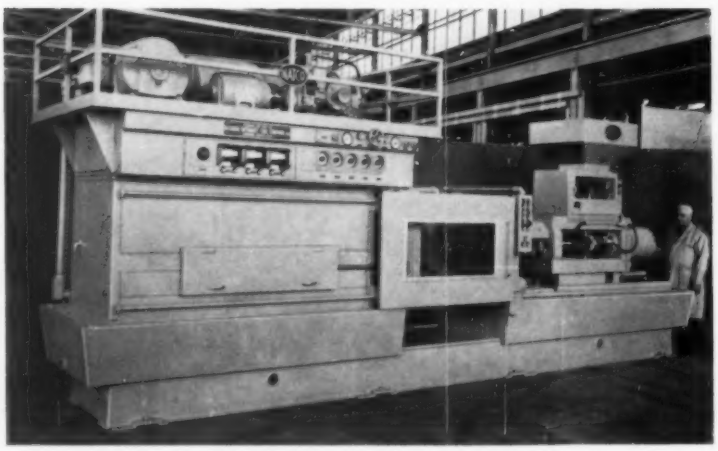
Designed to be mounted on any resin spray gun equipment, cutter weighing 3 lb. 2 oz., including the pneumatic motor, will cut roving at a rate of over 3 lb./min. The unit is pressurized by exhaust air from the motor giving positive and static-free delivery of cut fiber to the spray system. When properly adjusted, the cut fibers are shot into the spray which coats them and deposits the mix in the direction of the spray. The cutter will accept three packages of roving simultaneously, and speed of cutting is adjustable over a wide range. Cut lengths can be varied from ½ to 4 inches. The cutter unit only is priced at $325, including motor. *Finn & Fram Inc., 9765 Shadow Island Dr., Sunland, Calif.*



FINN & FRAM roving cutter is designed to be mounted on any spray gun system.

Injection machine

Natco 400X, 28-oz. injection machine has been designed for fast mold filling. Actual injection time for a full shot is 1.7 seconds. While the machine will mold all thermoplastics, it is expected to be especially useful for molding large, deep, thin-walled PE parts which require fast injection rates for proper filling and first quality finish. Like **(To page 194)**



NATCO 400X, a 28 oz. injection machine, has the entire hydraulic unit mounted overhead to save floor space.



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WORLD-WIDE PLASTICS DIGEST

Abstracts from the world's literature relative to plastics. For complete articles, send requests direct to publishers. List of addresses is at end of this section.

General

Nonwoven fabrics—How big, how soon? Chem. Eng. News 37, 118-23, 134 (Aug. 10, 1959). The production, types, and future of nonwoven fabrics are discussed. These products are made from acetate, acrylic, polyamide, polyester, and viscose fibers bonded with acrylate, butadiene copolymer, vinyl acetate, and vinyl chloride resins.

Theory of gas permeability of plastics film and sheeting. A critical literature survey. N. Buchner. Kunststoffe 49, 401-06 (Aug. 1959). The diffusion of gases through all types of plastic sheeting takes place according to one single law: the gas penetrates the film by means of "solution diffusion." The possibility of gas passing in the gaseous or adsorbed state through miscroscopic pores is discounted; plastic film and sheeting in the usual thicknesses are regarded as non-porous. The laws of "solution diffusion" are discussed.

Materials

New reinforced TFE plastics resist cold flow. N. L. Greenman. Materials in Design Eng. 50, 98-101 (Oct. 1959). Inorganic reinforcing fibers are added to polytetrafluoroethylene (PTFE) resin to improve resistance to cold flow and high temperature deformation under load. Five grades of reinforcing agents are described. Three of aluminum silicate ceramic fibers and two of glass fibers have been developed to yield better electrical and dry friction properties. The fibers are combined with the resin in a beater process, in which the resin in a water dispersion is added to a suspension of the fibers. The mixture is passed through beaters and formed into sheets. Each fiber is encapsulated by resin in the process. One of the PTFE-ceramic fiber combinations is used for antenna wave guide inserts in the reentry cones of missiles. Although the dielectric properties of the glass-fiber-reinforced material is better, the ceramic-reinforced material has better ablation characteristics and the surface does not carbonize, retaining undistorted signals.

Crystalline polymers of some nuclear-substituted styrenes. S. Murahashi, S. Nozakura, and H. Tadokoro. Bull. Chem. So. Japan 32, 534-35 (May 1959). Poly (p-methyl styrene), poly(m-methyl styrene), and poly-(p-trimethylsilyl styrene) were prepared with the Ziegler catalyst and crystallized by a heat treatment. The poly(p-methyl styrene) was crystallized by heat-treatment in a stretched state. Its crystallinity was rather low. The benzene fraction of poly(p-trimethylsilyl styrene was easily crystallized and highly crystalline even in an unoriented state. X-ray diffraction patterns suggest a complicated helical structure for these isotactic polymers.

Molding and fabricating

Selecting the proper marking process for plastics. H. O. Bates and W. A. Heine Jr. Plastics Tech. 5, 39-41, 50 (June 1959). Techniques for marking plastics are reviewed.

Determination of shrinkage, post-shrinkage, and swelling of molding powders. W. Woebcken. Kunststoffe 49, 373-81 (Aug. 1959). Phenolic and melamine plastic moldings are subject to shrinkage when heated, and swelling when exposed to moisture, both of which can lead to undesirable dimensional changes during use. The influence of processing techniques, especially in transfer molding, on dimensional stability can be expressed quantitatively by determining shrinkage, post-shrinkage, and swelling on a freshly molded test piece. A method of accomplishing this is described and results on standard molding compounds are given.

Liquefaction of thermoplastics—new melt process for extrusion and injection molding pre-plasticization. T. Engel. Kunststoffe 49, 406-07 (Aug. 1959). A melt extruder having very simple construction and low energy demand is prescribed. The granulated material is melted on a rotating radiant heated disk and the melt taken up by the screw to be extruded.

Applications

High-density polyethylene bottles. E. J. Temple. J. Soc. Cosmetic Chemists 10, 199-206 (1959). Bottles made of high-density polyethylene when properly designed and properly molded are superior in impact strength and resistance to corrosion cracking to those made from low-density polyethylenes. The high-density polyethylene bottles likewise have greater grease resistance and lower permeability to many of the volatile oils.

Plastics and passenger transport. J. D. Mundella. Plastics Inst. Trans. & J. 27, 97-100 (June 1959). Some of the factors involved in the design of passenger transportation vehicles of plastics are discussed. These include methods of manufacture, improvement in product, and new applications. The "all-plastics" vehicle is also considered.

Flexible packages for processed foods. R. G. Keller. Mod. Packaging 33, 145-49, 235, 239 (Sept. 1959). A variety of plastics films and film-foil laminates were evaluated for possible use as packaging materials to replace conventional containers in individual rations for Army personnel. The primary factors studied were resistance to sterilization temperatures; low gas and water permeability; and mechanical strength to maintain hermetic seals and sterility. Some films were found to be satisfactory in themselves; however, best results were obtained with foil laminates. These laminates generally gave superior permeability characteristics and also met the other necessary requirements.

Properties

Solarization studies on polyester resins using a heliostat-spectrometer. R. C. Hirt, R. G. Schmitt, and W. L. Dutton. Solar Energy 3, 19-22 (Apr. 1959). The solarization of polyester resins cross-linked with styrene using natural sunlight were studied. The dibasic acids present were varied among phthalic plus maleic, adipic plus maleic, succinic plus maleic, and all maleic. Sunlight was separated by a quartz prism monochromator and the ultra-violet portion of the solar spectrum was spread across the specimen. The activation spectrum is the degree of yellowing as a function of incident wavelength. Virtually identical activation spectra were obtained for the formulations, with maxima near 3300 A. Plots of yellowing versus the logarithm of the exposure gave straight lines, (To page 58)

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PLASTICS DIGEST

(From page 56)

showing that the resins obeyed the Hurter-Driffield law. Inertias and slopes were nearly the same for all formulations. In cases where the specimens were solarized at very high rates, a dark reaction was observed following exposure which caused a fading of the yellowing.

Surface properties of polyethylene: Effect of an amphipathic additive. A. J. G. Allan. J. Colloid Sci. *14*, 206-21 (Apr. 1959). Small amounts of amphipathic (polar non-polar) molecules such as oleamid cause a marked lowering of the coefficient of friction between thin films of polyethylene (PE). The wettability friction is reduced only when sufficient additive is present to form a weakly held monomolecular layer. This monolayer is formed by almost complete exudation of the additive from the bulk. The molecules are oriented on the surface so that the polar groups are in contact with the polyethylene and the hydrocarbon chains project into the air. The stability of the monolayer to water condensation is much improved by flame treatment of the film immediately on extrusion.

Properties of urethane foams related to molecular structure. R. E. Bolin, J. F. Szabat, R. J. Cote, E. Peters, P. G. Gemeinhardt, A. S. Morecroft, E. E. Hardy, and J. H. Saunders. J. Chem. Eng. Data *4*, 261-65 (July 1959). The molecular weight per branch point and other structural features for a number of polyether and polyester urethane foams are calculated and related to physical properties. The value calculated for molecular weight per branch point agrees qualitatively with the swell index. Increasing the molecular weight per branch points favors greater elongation, tear strength, resilience, elasticity, and low temperature flexibility. Decreasing the molecular weight per branch point favors greater compression strength, hysteresis, tensile modulus, and stiffness at lower temperatures in polyether foams. Aromatic rings increase firmness by causing a hindrance to rotation within the polymer. Polyester foams are firmer than the polyether foams within a similar molecular weight per branch point range. The compression set of semiflexible polyester foams is higher than that of semiflexible polyether foams. Ultimate tensile strength and compression set for both types of flexible foams are not affected significantly by the degree of cross linking.

Testing

Effect of mass of specimen on hardness values determined by dynamic methods. B. A. Bandyshev. Measurement Tech. (English translation of the Soviet journal Izmeritel'naia Tekhnika) No. 2, 144-46 (Mar.-Apr. 1958), published Aug. 1959. Equations for the relations between the mass of specimen and the results of hardness measurements obtained by dynamic methods are developed. In tests that were conducted in which a ball impacts a test specimen, the mass of the specimen should be 10 times the mass of the ball.

Estimation of thermal resistance of plastics. L. Kupf. Chem. Prumysl *9*, 153-57 (1959). Marten's method for the determination of thermal resistance of plastics was modified to eliminate the initial distortion of the specimen by adjusting the zero point of deformation after stress was applied for 5 minutes. Many different materials were studied and it was found that the measured thermal resistance approaches the true thermal resistance more closely when the specimen size is 6 by 6 by 50 mm. or smaller.

A modified rebound pendulum for evaluating flexible foams. L. A. Rosenthal and G. I. Addis. Rubber Age *85*, 790-94 (Aug. 1959). Greater detail in the study of impact properties of flexible foams may be obtained by a modified rebound pendulum which is described. Integration of the pendulum with a potentiometer yields angular position versus time curves, and also provides automatic recording of several impacts of the pendulum. The nonlinearity in resilience and dynamic deformation under impact are readily determined.

Effect of fluorinated refrigerants on cured polyester resins. J. Gaynor and G. W. Blum. J. Chem. Eng. Data *4*, 257-61 (July 1959). Some polyesters are suitable for contact with both Freon 11 and Freon 113 from 20 to 100° C. Much more Freon 11 than Freon 113 is absorbed by all polymers at all exposure temperatures and cure times. The mechanism by which solvent enters the structure is interaction with the surface and then diffusion into the volume of the polymer. Solvent is lost via a route analogous to that attributed to the drying of porous or packed solids. Polyester composition, exposure temperature, and cure time affect solvent resistance. Overcure and undercure are detrimental; the latter is more serious. The overriding effect, however, is composition.

Chemistry

Dye sensitized photopolymerization of vinyl compounds. Polymerization of styrene by cyanine dyes. III. A. Watanabe. Bull. Chem. Soc. Japan *32*, 557-64 (June 1959). Studies on the photopolymerization of styrene with cyanine dyes were conducted. Chain initiation is promoted by direct interaction between the excited dye and the styrene molecule. Activation energies for the initiation step were determined for several dyes of iodide, bromide and chloride. In general the activation energy depends on the kind of halogen ion; from this it was concluded that the halogen ion plays an essential role in the reaction. The activation energy decreased as the wavelength of the absorption maximum of dyes became shorter.

Polymerization. F. H. Bolton. Ind. Eng. Chem. *51*, 1135-41 (Sept. 1959). The literature on polymerization for the past year is reviewed and summarized. 363 references.

Publishers' addresses

Bulletin of Chemical Society of Japan: Nippon Kagaku Zassi, #5, 1-Chome, Surugadai Kanda Chiyoda-ku, Tokyo, Japan.

Chemical and Engineering News: American Chemical Society, 1155 Sixteenth St., N. W., Washington, D. C.

Chemicky Prumysl: Prumyslove Vydavatelstvi, Panska 2, Prague (11), Czechoslovakia.

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Journal of Applied Chemistry: Society of Chemical Industry, 56 Victoria St., London SW1, England.

Journal of Chemical Engineering Data: American Chemical Society, 1155 Sixteenth St., N. W., Washington, D. C.

Journal of Colloid Science: Academic Press Inc., 125 E. 23rd St., New York, N. Y.

Journal of Society of Cosmetic Chemists of Great Britain: 33 Devereux Dr., Watford, Herts. England.

Kunststoffe: Karl Hanser Verlag, Leonard-Eck-Strasse 7, Munich 27, Germany.

Materials in Design Engineering: Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

Measurement Techniques: Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

Modern Packaging: Modern Packaging Corp., 575 Madison Ave., New York 22, N. Y.

Plastics Institute Transactions and Journal: The Plastics Institute, 6 Mandeville Pl., London W1, England.

Plastics Technology: Bill Brothers Publishing Corp., 630 Third Ave., New York 17, N. Y.

Rubber Age: Palmerton Publishing Co. Inc., 101 W. 31st St., New York 1, N. Y.

Solar Energy: Assn. for Applied Solar Energy, Central Plaza Bldg., 3424 N. Central Ave., Phoenix, Ariz.—End

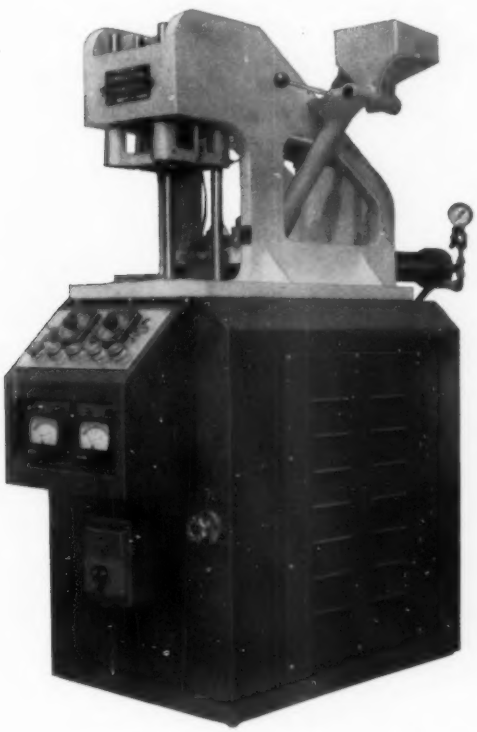
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U.S. Pats., Aug. 18, 1959

Glycidyl polyether of dihydric phenol. D. Wasserman (to Minnesota Mining). U. S. 2,900,364.

Organophosphorus polymers. A. C. Haven, Jr. (to Du Pont). U. S. 2,900,365.

Novel thermosetting resins. T. J. Suen and Y. Jen (to American Cyanamid). U. S. 2,900,367.

Polyurethanes. F. B. Stilmar (to Du Pont.) U. S. 2,900,368.

Polyamides. W. M. Edwards and I. M. Robinson (to Du Pont). U. S. 2,900,-369.

Copolymerization of vinyl aryl sulfonates. W. K. Wilkinson (to Du Pont). U. S. 2,900,370.

Ethylene polymerization. W. F. Gresham and N. G. Merckling (to Du Pont). U. S. 2,900,372.

Ethylene polymerization. J. W. Martin, Jr. (to Koppers). U. S. 2,900,373.

Ethylene polymerization. R. S. Aries. U. S. 2,900,374.

U.S. Pats., Aug. 25, 1959

Modified urea resins. L. H. Wilson and Y. Jen (to American Cyanamid). U. S. 2,901,391.

Propylene copolymers. A. J. Morway, C. W. Seelbach, and D. L. Cottle (to Esso). U. S. 2,901,432.

High-molecular weight materials. W. Starck, H. Starck, and F. Schulde (to Lucius and Bruning). U. S. 2,901,443.

Polymers from phosphine compounds. L. H. Chance, G. L. Drake, Jr., and W. A. Reeves (to United States). U. S. 2,901,444.

Cellular polyurethanes. R. F. Harris (to Du Pont). U. S. 2,901,445.

Expanded polyvinyl chloride. L. G. Hawkins (to Whiffen). U. S. 2,901,-446.

Organosilicon condensates. R. Schwartz, W. Kuchen, and F. Weigel (to Siemens-Schuckert-werke). U. S. 2,901,449.

Reacting a polymeric lactam with a polymeric acid. G. G. Stoner and G. C. Wright (to General Aniline). U. S. 2,901,457.

Copolymers of olefines. F. W. Banes and W. P. Fitzgerald (to Esso). U. S. 2,901,458.

Curable compositions. V. Auerbach and A. K. Ingbermann (to Union Carbide). U. S. 2,901,461.

Epoxy resins. J. Anderson and D. S. Melstrom (to Shell). U. S. 2,901,462.

Dioxo-bis-guanimine resins. F. C. Schaefer and L. A. Landers (to American Cyanamid). U. S. 2,901,464.

Polyesters. J. H. Sample (to Sherwin-Williams). U. S. 2,901,465.

Linear polyesters. C. J. Kibler, A. Bell and, J. G. Smith (to Eastman Kodak). U. S. 2,901,466.

Polyurethane coating. C. W. Croco (to Du Pont). U. S. 2,901,467.

N-containing polymers. K. Meinel (to Wacker). U. S. 2,901,468.

Coating. J. C. Cowan and H. M. teeter (to United States). U. S. 2,901,469.

Polymers of multivinyl aromatics. W. F. Gresham (to Du Pont). U. S. 2,901,470.

Isobutylene polymerization. M. A. Pavlick (to Esso). U. S. 2,901,471.

U.S. Pats., Sept. 1, 1959

Graft copolymers. R. G. W. Norrish (to Distillers). U. S. 2,902,420-1.

Dielectric compositions. S. D. Ross (to Sprague Electric). U. S. 2,902,451.

Cellular polyurethanes. E. Gee, P. C. Johnson, E. A. Packer, and K. Stephenson (to Imperial Chemical). U. S. 2,902,456.

Adhesive. J. Teppema (to Borden). U. S. 2,902,458-9.

Polyvinyl halide compositions. G. B. Jennings and C. E. Parks (to Goodrich). U. S. 2,902,460.

Polyesters of diphenyladipic acid. C. E. Frank and H. Greenberg (to National Distillers). U. S. 2,902,461-2-3.

Polymerization of vinylidene monomers. E. C. Chapin and L. P. Paradis (to Monsanto). U. S. 2,902,464.

Stabilizers. A. Bavley, C. J. Knuth, and M. W. Miller (to Chas. Pfizer). U. S. 2,902,465.

Silicones. A. D. Chipman and P. Fianu (to Dow Corning). U. S. 2,902,-467-8.

Linear polyesters. C. A. Burkhard (to General Electric). U. S. 2,902,-469.

Polyacetals. B. H. Kress (to Quaker Chemical). U. S. 2,902,470.

Epoxy ether polymers. P. Bruin (to Shell). U. S. 2,902,471.

Dicyandiamide triethylene tetramine condensate. A. A. Cooke and I. Sapers (to Arkansas). U. S. 2,902,472.

Polyesters of fluorinated glycols. D. D. Smith (to Dow Corning). U. S. 2,902,473.

Curing polyurethanes. R. G. Arnold and D. M. Simons (to Du Pont). U. S. 2,902,474.

Linear polyamides. C. A. Burkhard (to General Electric). U. S. 2,902,-475.

Diallylidene pentaerythritol copolymers. W. Kern and G. All'Asta (to Hercules). U. S. 2,902,476.

Perfluorochloroolefin polymers. E. Fischer, K. Weihsermel, and G. Bier (to Lucius & Bruning). U. S. 2,902,-477.

U.S. Pats., Sept. 8, 1959

Extrusion. R. Colombo (to Materie Plastiche). U. S. 2,902,716.

Vacuum forming. G. Martelli, N. Martelli, and F. Martelli, U. S. 2,902,-718.

Extrusion. E. N. Meakin. U. S. 2,902,-949.

Rigid polyurethane foams. P. Hoppe and H. Paffrath (to Bayer and Mobay). U. S. 2,903,380.

Injection-molded reinforced parts. R. Jonke and J. Lintner. U. S. 2,903,-388.

Molding reinforced plastics. T. Fujita. U. S. 2,903,389.

Thermosetting resin. R. G. Heiligmann (to Esso). U. S. 2,903,440.

U. S. Pats., Sept. 15, 1959

Polyethylene. W. C. Rainer, E. M. Redding, J. J. Hitor, A. W. Sloan, and W. D. Stewart (to W. R. Grace). 2,904,480.—End



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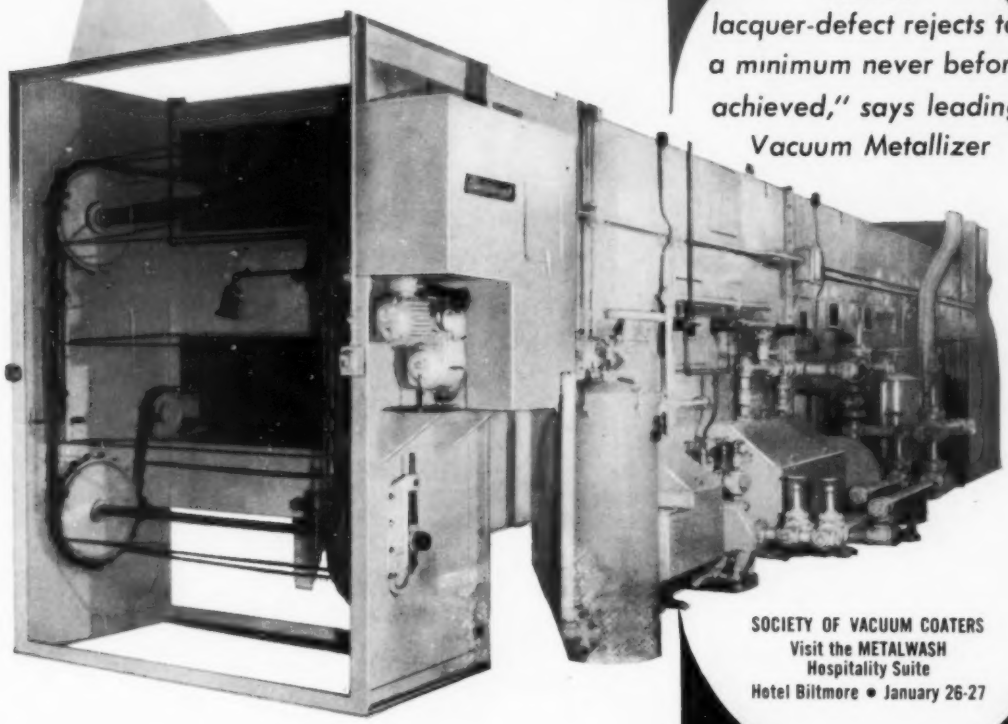
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This Automated Finishing System for Vacuum Metallizing preparation is an example of what METALWASH engineering experience and skill can do for you.

FAST / Delivers one rack of work per minute.

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Opal 'Perspex' display stand specially designed by R. Stennett-Willson for J. Wuidart & Co. Ltd., London

Opal 'Perspex' was chosen to display modern glass

TO DISPLAY modern, fine glass so that its background enhances the colour and form without intruding is a very difficult task. R. Stennett-Willson of J. Wuidart & Co. Ltd. chose opal 'Perspex' acrylic sheet to enclose the light source so that the display stands would give an even diffuse light which would show clearly the shape and colour of the glassware without distracting highlights and reflections.

The stand is simple, clean in line and displays the glass to advantage because the opal 'Perspex' contrasts with the glass but remains a background.

'Perspex' acrylic sheet is available in a range of attractive modern colours in opal, transparent, translucent and opaque colours as well as in clear sheet. It is tough, light in weight and easy to clean and maintain.



·PERSPEX·

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

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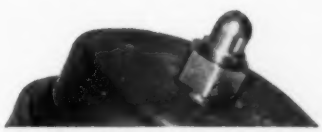
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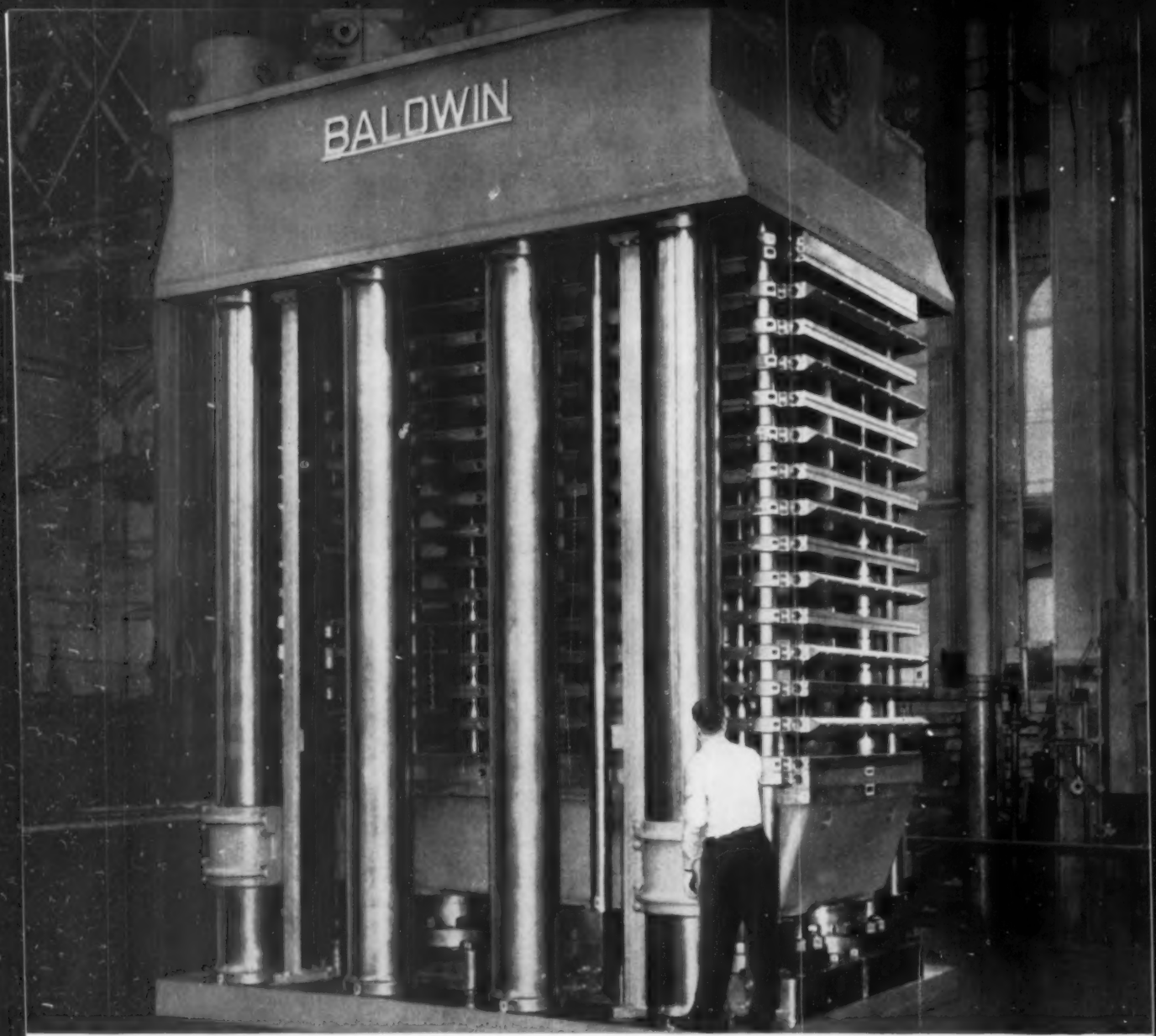
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The new Hamilton steam platen press pictured above is the fourth to be installed at Formica Corporation's Evendale plant. Each press is capable of developing pressures of more than 4500 tons over a 4 x 10 ft. surface.

Baldwin steam platen presses serve the nation's laminating industry

Baldwin Steam Platen Laminating Presses may be found in virtually every one of the nation's modern laminating plants. To name but a few of them: Formica Corporation, General Electric, Westinghouse, Continental Diamond Fibre Company, Synthane Corporation, Parkwood Laminates, Inc., National Plastic Products Company, Panelyte Division of the St. Regis Paper Company, Spaulding Fibre Company, Richardson Company, Taylor Fibre Company.

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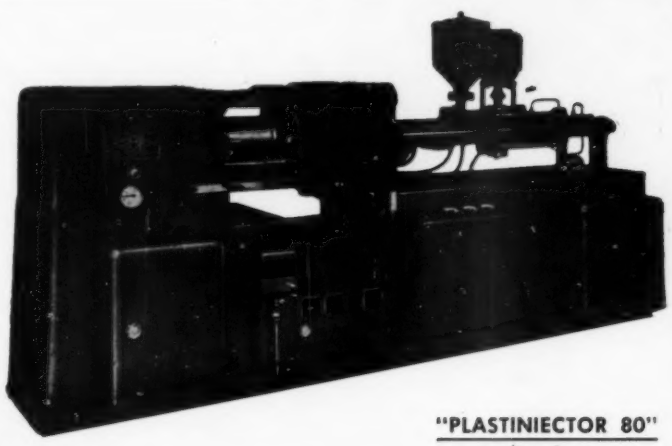
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8 REASONS WHY PLASTICS MEN NOW REGARD

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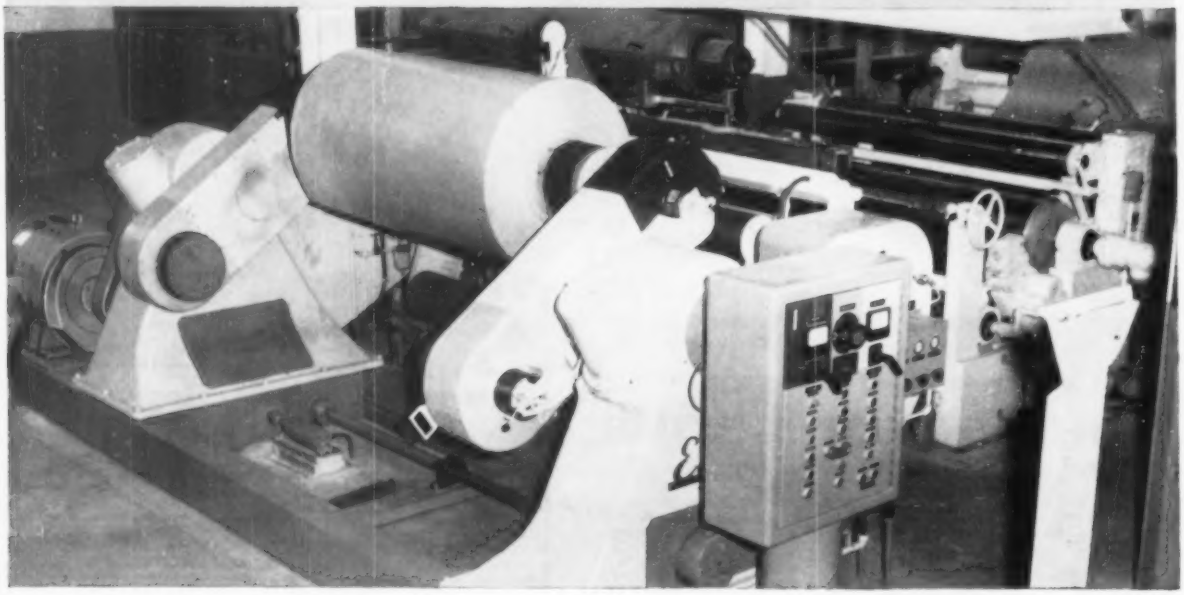
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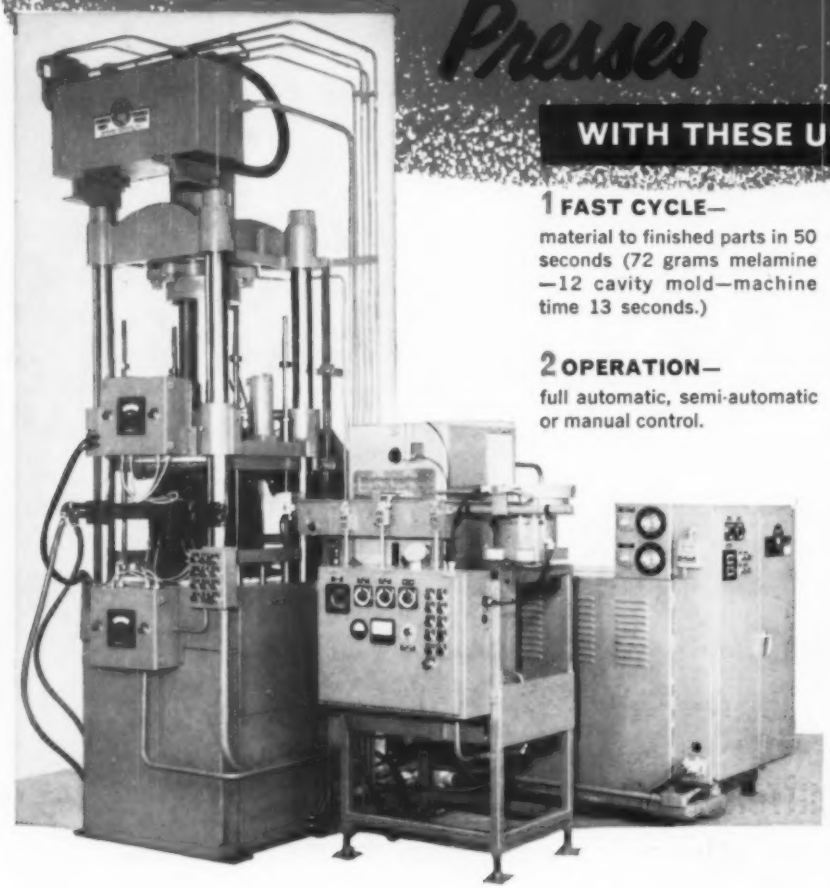
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NEW Rodgers AUTOMATIC TRANSFER and COMPRESSION MOLDING Presses



WITH THESE UNIQUE FEATURES:

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material to finished parts in 50 seconds (72 grams melamine —12 cavity mold—machine time 13 seconds.)

2 OPERATION—
full automatic, semi-automatic or manual control.

3 PART EJECTION—
hydraulically operated top or bottom ejection—air operated hold up or hold down insures parts stay in desired mold half.

4 INSULATED MOLD MOUNTING PLATE—
to keep heat in mold, and keep press platens and system cool.

5 TRANSFER TO COMPRESSION—
changeover accomplished by turning selector switch.

6 LARGE PLATEN AREA—
front and left side accessible to install mold and set up.

7 AUTOMATIC PREFORM PREHEATER-LOADER—
self contained, 3 kilowatt unit, also adaptable to other press installations.

● Here's a step forward in plastic molding presses . . . a product of Rodgers research and development program, designed to provide new standards of performance for the plastic industry. With many unique features and an unusual versatility of operation, these presses offer the advantages of speed, economy and flexible operation.

Rodgers TCMA presses are available in standard models of 100, 150 tons with 24" x 20" platen, 200 tons with 30" x 24" platen, 300 tons with 36" x 30" platen. Send print or part and production requirements for details and recommendations on the size, type of press and accessory equipment to help you produce more pieces at lower cost.

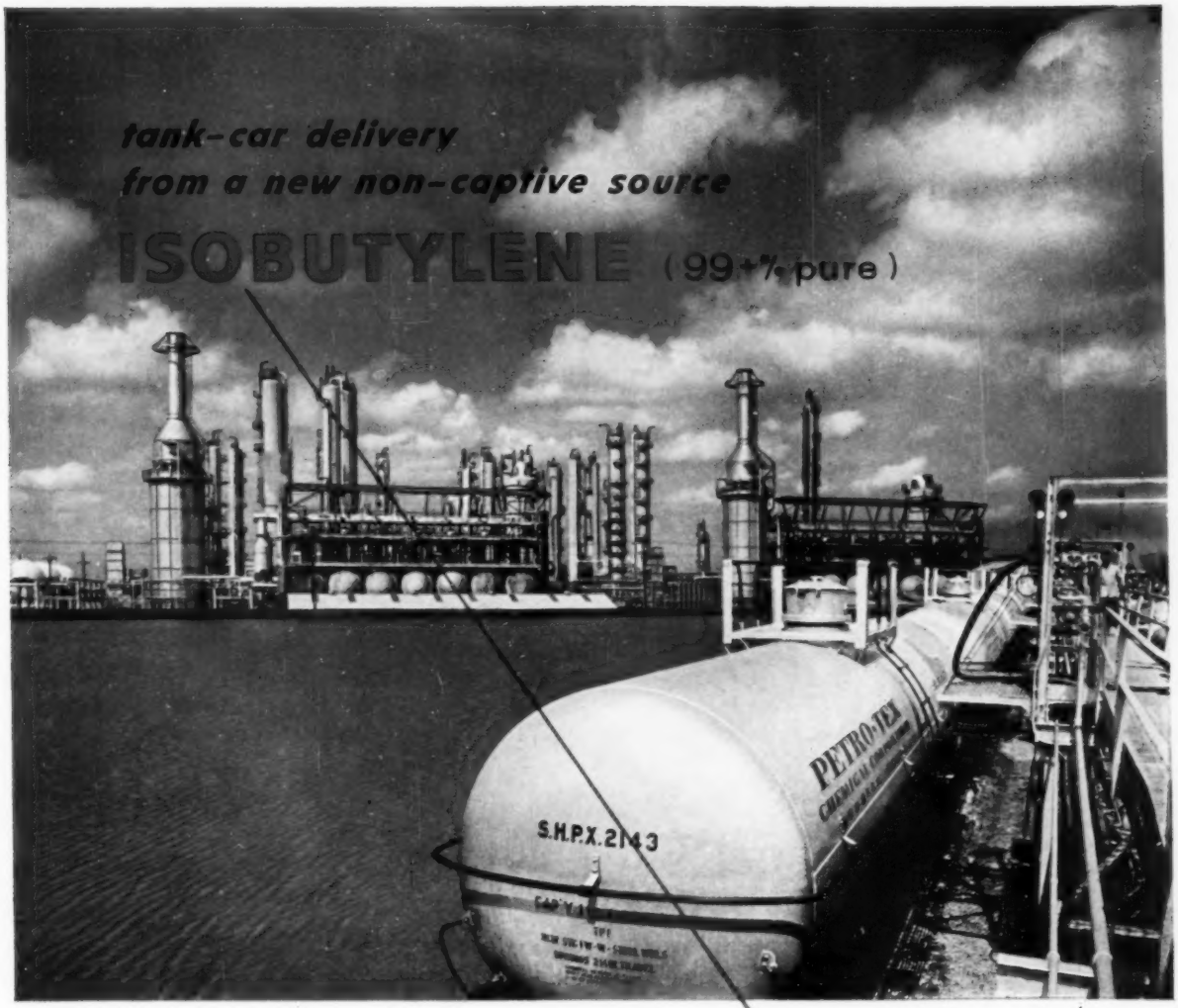
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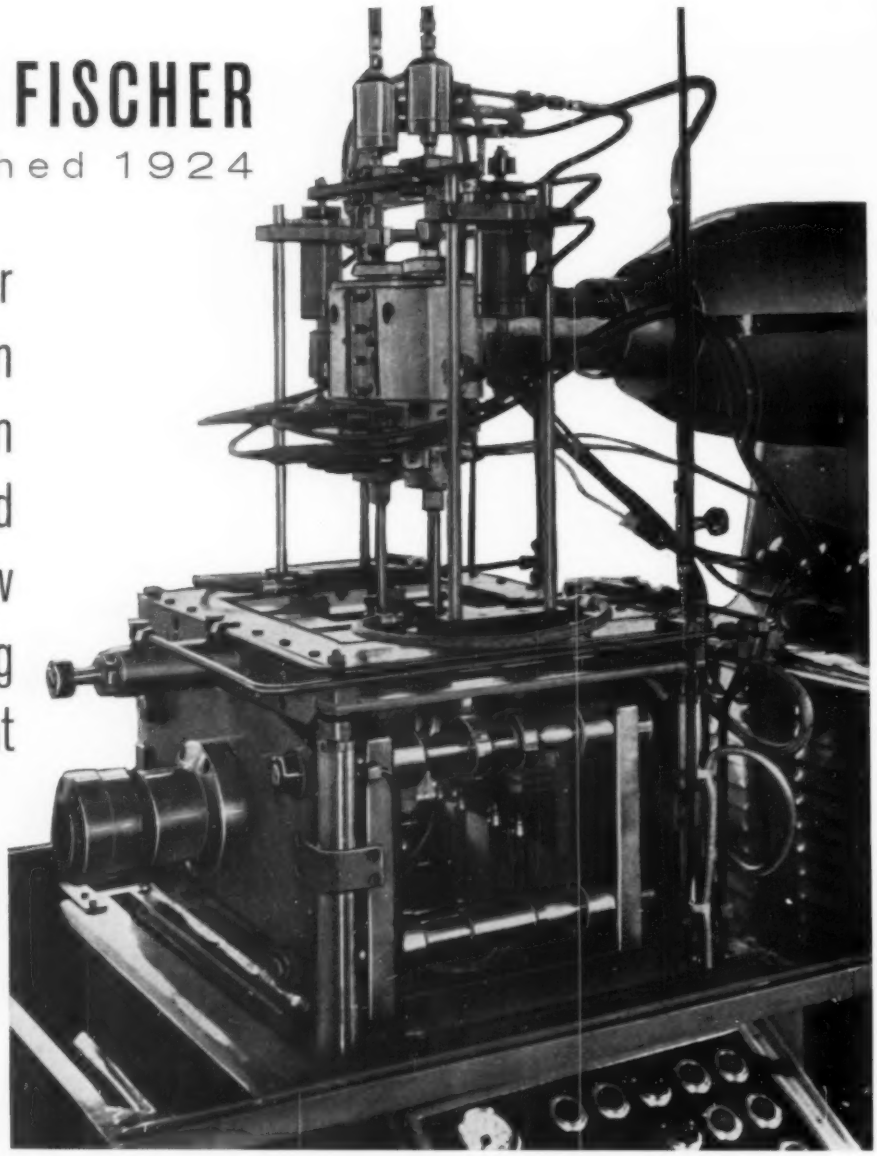
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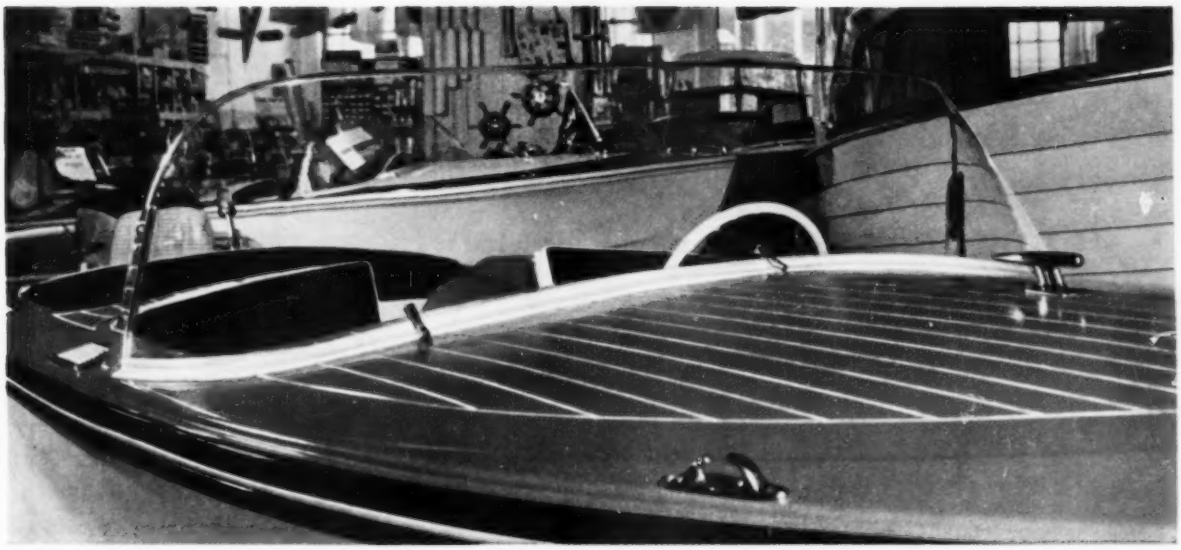
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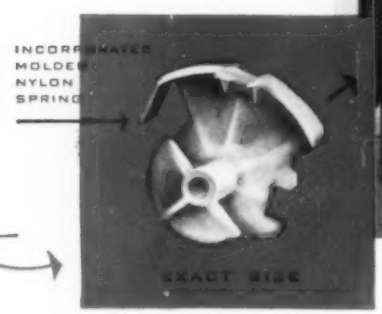








Becomes a Single Part in Molded Nylon by-Quinn Berry





An almost fantastic challenge! . . . Quinn-Berry engineers and craftsmen replaced the 4 piece brass, phosphor bronze and strip steel assembly of the actuator in the Automatic Voting Machine by a single molded nylon part . . . the manufacturer effected an equally fantastic saving.

Note in the above illustration how the single molded nylon part, shown in actual size, eliminated a tedious and delicate assembly job on the manufacturer's production line. Molded to the most exacting tolerances, this nylon actuator is self lubricating, quiet and completely accurate in operation, a vital requisite in Automatic Voting Machine operation.

Such challenges are being met daily at Quinn-Berry where the Unusual is Routine. Consult with us on the use of molded thermoplastics . . . you too may be able to effect amazing cost savings.

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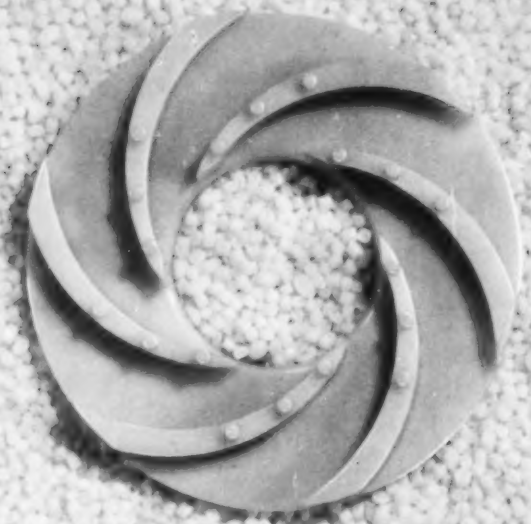
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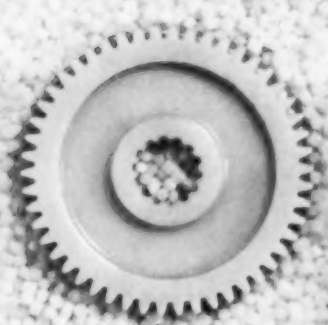


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Du Pont announces



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ACETAL RESIN



...a completely new engineering material offering a combination of properties unmatched by any other thermoplastic

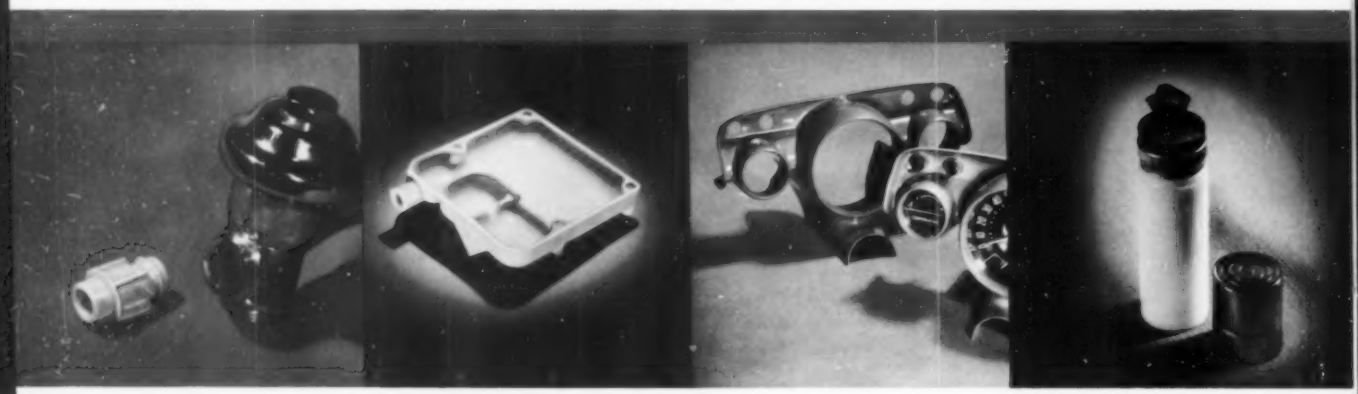
This is Du Pont Delrin®:

"Delrin" acetal resin is a highly crystalline, stable form of polymerized formaldehyde. This completely new material offers you metal-like mechanical properties, such as a high degree of strength and rigidity, plus other properties that metals do not possess.

The combination of properties offered by "Delrin" is unequaled by any other thermoplastic. For example, "Delrin" has high dimensional stability, tensile and flexural strength, resilience and toughness. Most importantly, "Delrin" retains these desirable properties under a wide range of service conditions—temperature, humidity, solvents and stress.

Over the past three years, "Delrin" has been

Typical performance and production advantages of "Delrin"



A brass part in a commercial flush valve was duplicated in "Delrin". This part operated perfectly for 18 months—the period of test—although it was completely and continuously immersed in water. The outstanding dimensional stability of "Delrin" under a wide variety of service conditions has also been proved, for example, in showerheads (continuously running water at 150°F.), and movie projector gears (run over 2,000 hours at ambient humidity).

This textile solution pan is ordinarily made of stainless steel. It must have resistance to oils and organic solvents, a clean, smooth surface; it also requires several threaded inserts plus other details. In normal quantities, stainless steel pans cost approximately $25 each. Injection molded in "Delrin", the cost was quoted at about $3 each. Testing showed that "Delrin" provided the required finish without machining, the needed solvent resistance, plus a weight saving of 75%.

A zinc die-casting mold was used to make this instrument cluster of "Delrin". Weight was reduced over the zinc component by almost 80%. In addition to manufacturing economies, further savings in assembly are indicated: self-tapping screws can be used, since the creep resistance of "Delrin" prevents loosening or stripping. These clusters can be molded in integral color or painted, and with a conventional mold would require little, if any, mechanical finishing.

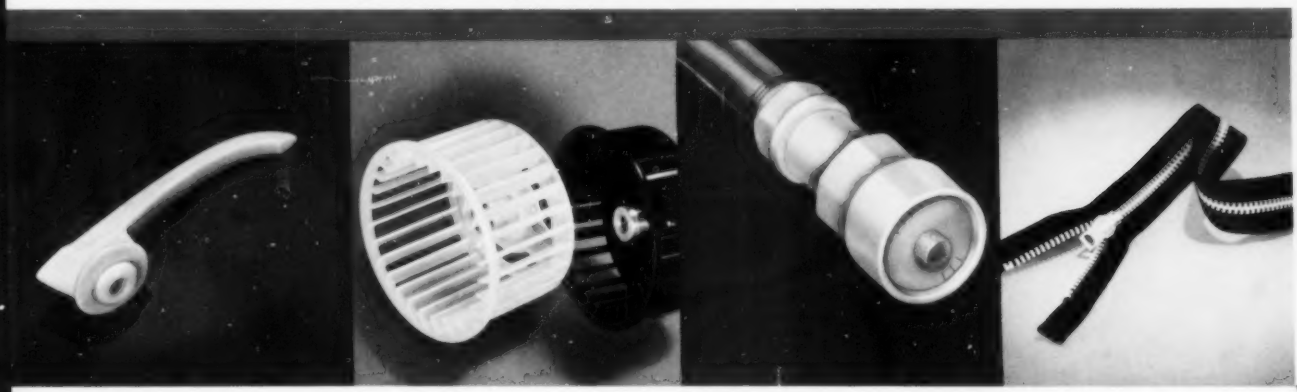
Aerosol containers made of "Delrin" were shelf-stored for over a year; others stored for 3 months at 130°F. In both cases, the contents were still completely dischargeable. "Delrin" retains its strength and toughness for long periods, even when exposed to elevated temperatures and organic solvents. Equally important are the new opportunities for high styling opened by "Delrin"—the freedom to design in new shapes and integral colors to suit purchasing trends.

tested in hundreds of end-use applications by a host of industrial concerns. These tests have confirmed that parts made of "Delrin" can compete *on a performance and cost basis* with parts made of many metals, rubber, glass or wood. Of the various end-uses tested, 75% would normally be made of metal and another 10% of rubber, glass or wood. These tests have resulted in many applications of "Delrin" now being readied for commercial production—including gears, bearings, housings, containers, plumbing and hardware parts, pump impellers, "squirrel-cage" blowers, door handles, clothing fitments and many others.

In addition to metal-like performance, "Delrin" offers you the manufacturing economies inherent in the production methods of the plastics industry. "Delrin" is easily injection molded, extruded, blow-molded or fabricated with conventional machine tools.

Illustrated below are a few of the applications of "Delrin" which have undergone extensive field service tests. The performance and economies listed were indicated during comparative evaluations made with materials in use at the time of the tests. These applications, together with additional data on the following page, may well suggest ways in which this versatile new engineering material can help *you* improve a product, lower its cost or develop new designs for your profit. Your inquiry is invited (see coupon on next page).

evaluated during three years of field tests . . .



Accessories usually made of metal, such as automotive window cranks and refrigerator door handles, can be economically mass-produced in "Delrin" by injection molding. "Delrin" provides required strength and rigidity. Integral colors, a variety of surface effects and functional details can be produced in one operation. Less weight, improved styling, dependable performance and potential cost savings are made possible by "Delrin".

Industrial components such as this "squirrel-cage" blower—as well as a variety of gears, bearings and other mechanical parts—have demonstrated the ability of "Delrin" to compete with various metals on a performance and cost basis. "Delrin" offers excellent fatigue life even when immersed in oil or water. Rapid production of lightweight, intricate components by the injection molding process can lead to substantial manufacturing economies with "Delrin".

Plumbing fixtures made of "Delrin", such as this showerhead, offer the manufacturer new styling and design advantages . . . and the home owner new latitudes in bathroom décor. Injection molded in integral color, fixtures made of "Delrin" assure builders and home owners of long-term dimensional stability, freedom from rust and mineral build-up. Modern in design, they are durable and dependable in service, and provide opportunities for potential cost savings.

Clothing fitments, such as zippers, clasps and snaps, are also readily and economically molded in "Delrin". Stiffness, toughness and resistance to heat, body oils and perspiration make "Delrin" a logical choice for such uses. Your customers would welcome the light weight, colorability and warm-to-the-touch benefits "Delrin" offers. Extensive field tests have demonstrated that "Delrin" is one of the most promising new materials available to the fitments industry.

TYPICAL PROPERTIES OF "DELRIN" ACETAL RESIN

PROPERTY		ASTM NO.	AVERAGE VALUES FOR TEST BARS MOLDED AT	
			500X	150X
Elongation	—68°F.	D638	13%	38%
	73°F.	D638	15%	75%
	158°F.	D638	330%	460%
Impact strength, Izod	—40°F.	D256	1.2 ft.lb./in.	1.8 ft.lb./in.
	73°F.	D256	1.4 ft.lb./in.	2.3 ft.lb./in.
Tensile strength and yield point,	—68°F.	D638	14,700 psi	
	73°F.	D638	10,000 psi	
	158°F.	D638	7,500 psi	
Compressive stress at 1% deformation		D695	5,200 psi	
at 10% deformation			18,000 psi	
Flexural modulus,	73°F.	D790	410,000 psi	
	170°F.	D790	190,000 psi	
	250°F.	D790	90,000 psi	
100% RH 73°F.		D790	360,000 psi	
Flexural strength		D790	14,100 psi	
Sheer strength		D732	9,510 psi	
Heat distortion temperature,	264 psi	D648	212°F.	
	66 psi	D648	338°F.	
Fatigue endurance limit, 50 to 100% RH 70°F.			5,000 psi	
100% RH 150°F.			3,000 psi	
Water absorption, 24 hours immersion		D570	0.12%	
equilibrium, 50% RH		D570	0.2%	
equilibrium, immersion, 77°F.			0.9%	
Specific gravity		D792	1.425	
Rockwell hardness		D785	M94, R120	
Flammability		D635	1.1 in./min.	
Melting point (crystalline)			347°F.	
Flow temperature		D569	363°F.	

PROPERTY	ASTM NO.	AVERAGE VALUES FOR TEST BARS MOLDED AT 500X
Deformation under load (2,000 psi at 122°F.)	D621	0.5%
Coefficient of linear thermal expansion	D696	4.5×10^{-5} per °F.
Taber abrasion (1000 gm. load, CS-17 wheel)	D1044	20 mg/1000 cycles
Thermal conductivity		1.6 BTU/hr./sq. ft./°F./in.
Specific heat		0.35 BTU/lb./°F.
Modulus of rigidity		178,000 psi
Poisson's ratio		0.35
Dielectric constant, 73°F., 10^2-10^5 cps	D150	3.7
Dissipation factor, 73°F., 10^2-10^5 cps	D150	.004
Dielectric strength, short time	D149	500 V/mil
Volume resistivity	D257	6×10^{14} ohm/cm
Resistivity	D257	2×10^{13} ohm
Arc resistance	D495	129 seconds (burns)

		P Factor at 73° F.:	
Permeability:	Water	1.9	gms. loss/24 hrs./100 in² area/mil thickness. Determined on bottles with 35-50 mil wall thickness.
	Ethanol	0.2	
	Freon® 12-114 (20/80)	< 0.2	
	Methyl Salicylate	0.3	

		Room Temp.	122° F	
Resistance to Organics:	CCl_4	1.2	5.7	% wgt. gain—12 mo. total immersion Vol. change proportional to wgt. change.
	Toluene	2.6	2.8	
	Acetone	4.9	2.6	
	Alcohol	2.2	1.9	
	Ethyl Acetate	2.7	2.9	

*These values are representative of those obtained under standard ASTM conditions and should not be used to design parts which function under different conditions. Since they are average values, they should not be used as minimums for material specifications.

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"Delrin" acetal resin offers you a combination of properties and potential cost advantages never before offered by any single material. Specific values of typical properties of "Delrin" are listed in the table above . . . and the advantages implicit in these figures have been thoroughly tested in a wide variety of end-uses.

Today is your best opportunity to consider how Du Pont "Delrin" can help you improve the design of a product or develop your designs on new products. Within the next few weeks a new plant to manufacture "Delrin" in commercial quantities will come on stream at Parkersburg, W. Va. This plant is your assurance that your design improvements can fast become practical realities. Commercial molders, already familiar with "Delrin", can provide you with valuable assistance in your problem.

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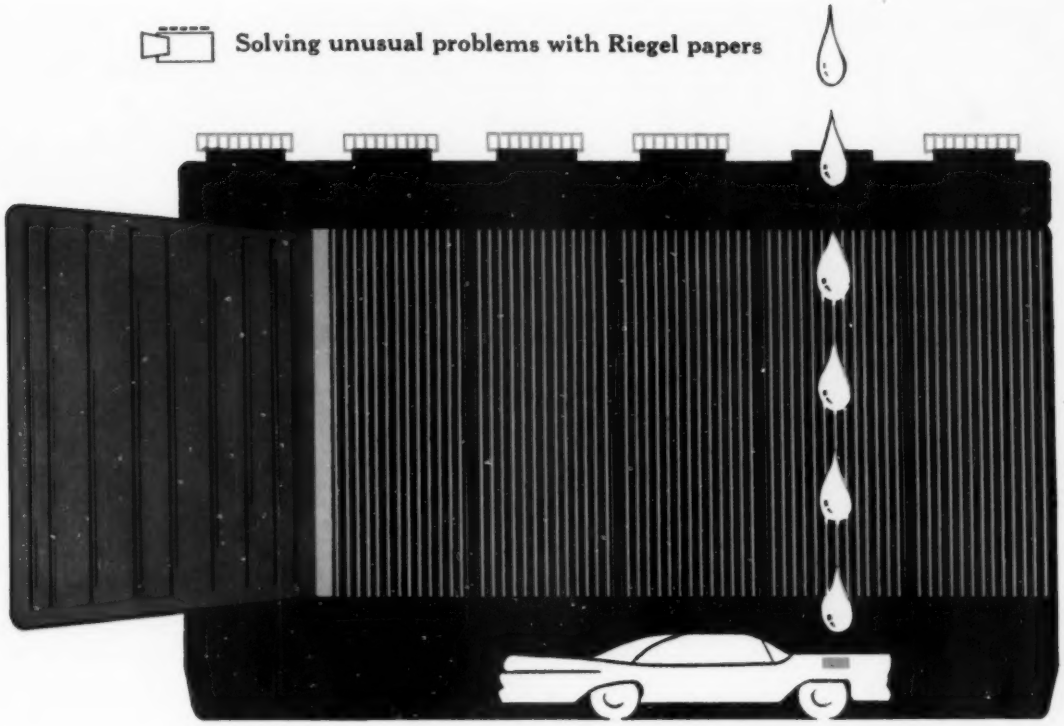
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NEWS ABOUT

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These polypropylene experts can help you with development work in new applications for Spencer "Poly-Pro" Polypropylene. Fabricated forms, such as rod stock, bar stock and film samples are available now at Spencer for product testing and evaluation. "Poly-Pro" resins are available from a pilot plant only. Contact your Spencer Plastics Sales Representative for complete information.

How You Can Benefit from Spencer's POLY-PRO End-Use Development Program:

Do you have a product idea that needs help? Chances are good you can find the answer in Spencer Chemical Company's polypropylene market applications research. This extensive end-use development program now underway is supported by years of experience in other thermoplastic resins.

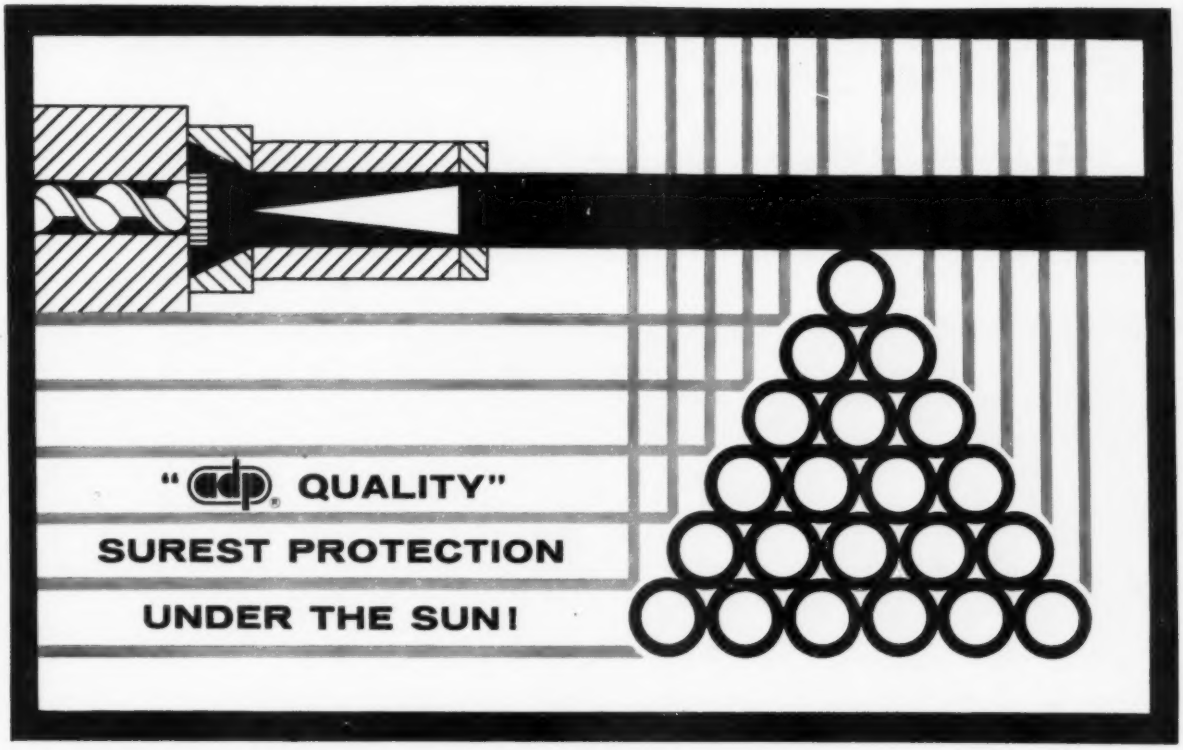
Knowledge in this field can be used for the development of engineered applications currently in other materials where performance is marginal or costs are too high. Spencer's plastics experience also can be used for developing packaging applications utilizing films, coatings, laminates, skin packaging and blow molding. Other polypropylene applications being researched are tubing, pipe and monofilaments.

May we work with you? Now is a good time to take advantage of Spencer's polypropylene development help. Simply contact your Spencer Plastics Sales Representative, or write to Polypropylene Product Manager at the address below.

Commercial quantities of "Poly-Pro" Polypropylene resins will be available shortly after the first of the year.

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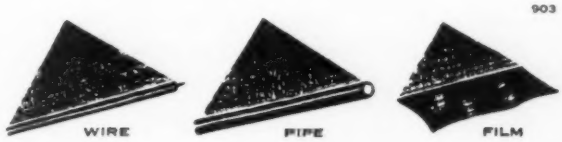
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"ADP Quality" carbon black dispersions provide equally protective coloration for wire, filament, and film extrusions. Acheson also supplies ADP concentrates in all standard colors for a wide variety of plastics applications.

Write today for a sample of ADP concentrates in the resin you require . . . or let Acheson specialists work with you to solve your special coloring problems.

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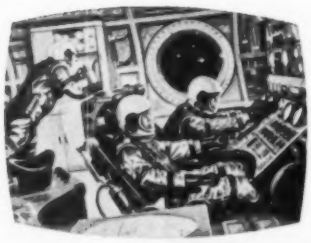
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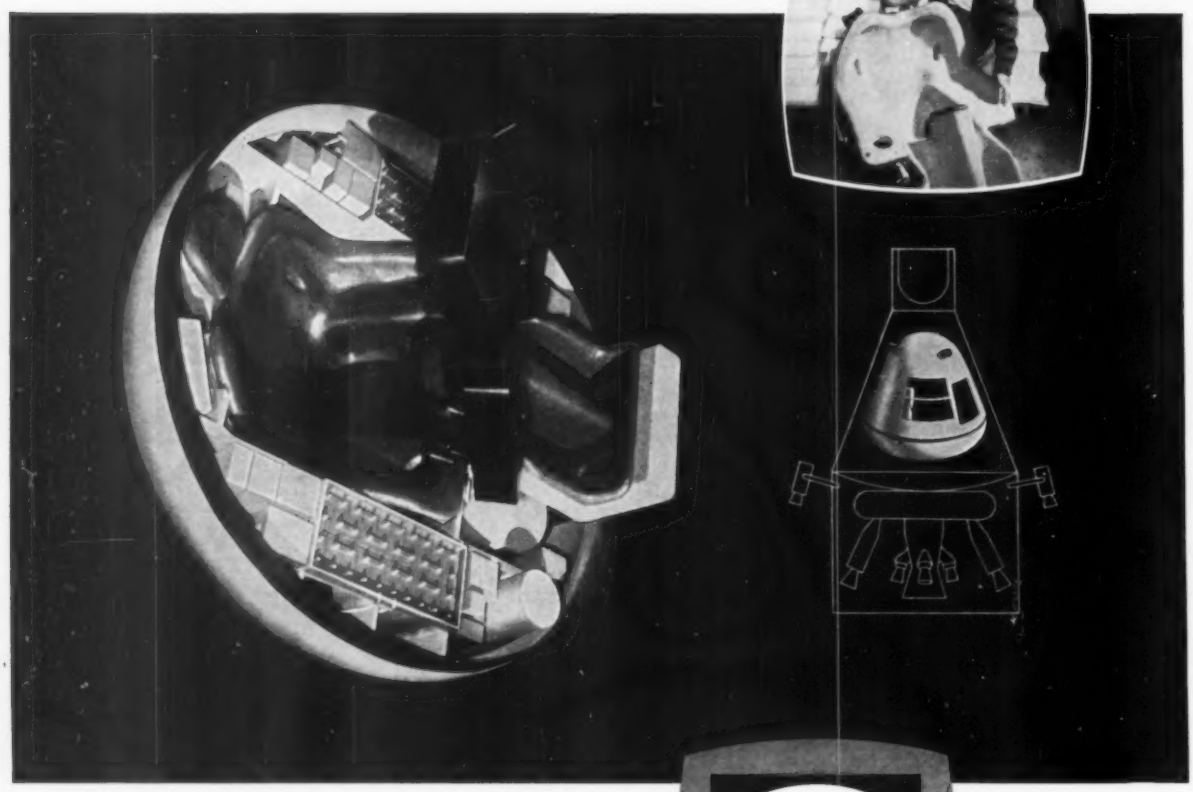
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Space for Stafoam today!



A few months ago we published an advertisement featuring the illustration above, predicting the many uses for *Stafoam* urethane products in manned space ships of the future..



Actual photograph of prototype manned capsule, a major element of maneuverable satellite for rendezvous in space, under development by the Astro Systems Research Laboratories, Norair, Division of Northrop Corp.

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For a new dimension in material technology, contact the Freedlander R & D Laboratories, American Latex Products Corp., or its branches. Specify product requirements and/or material category.

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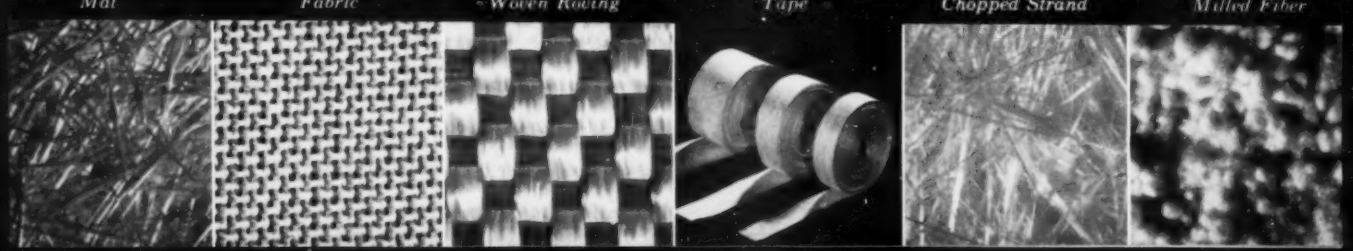
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Resilient synthetic O-ring seat seals, combined with direct metal-to-metal seat stops, assure a positive seal without O-ring deterioration, even in severest service. Side-to-side contact of the O-ring seals with the seats, plus special stem packers, result in leak-free performance and maximum service life.

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For more than three years we have been providing our customers for Oxo Alcohol with technical service on the use of our material. We work with them on their process difficulties. We endeavor to show customers how to accomplish savings on both processing and time by taking full advantage of the superior quality of our alcohols. The better and more consistent initial quality of AMOCO Oxo Alcohols results in crude esters that require less bleaching to meet color specifications. Also, less trouble is encountered with the re-use of unreacted alcohol.

The extremely low carbonyl content, excellent esterification color, acid color, and storage stability of AMOCO Oxo Alcohols has resulted in these products finding widening application in the manufacture of ester plasticizers. Manufacturers of didecyl phthalate plasticizers in particular are finding the "something more" in AMOCO Decyl Alcohol. DDP made from AMOCO Decyl Alcohol produces vinyl compounds with excellent mechanical properties. The superior permanence properties of AMOCO Decyl-derived DDP makes such plasticizers particularly suitable for vinyl compounds used in electrical applications.

Perhaps we may be of assistance to you. We will give your inquiry immediate attention.

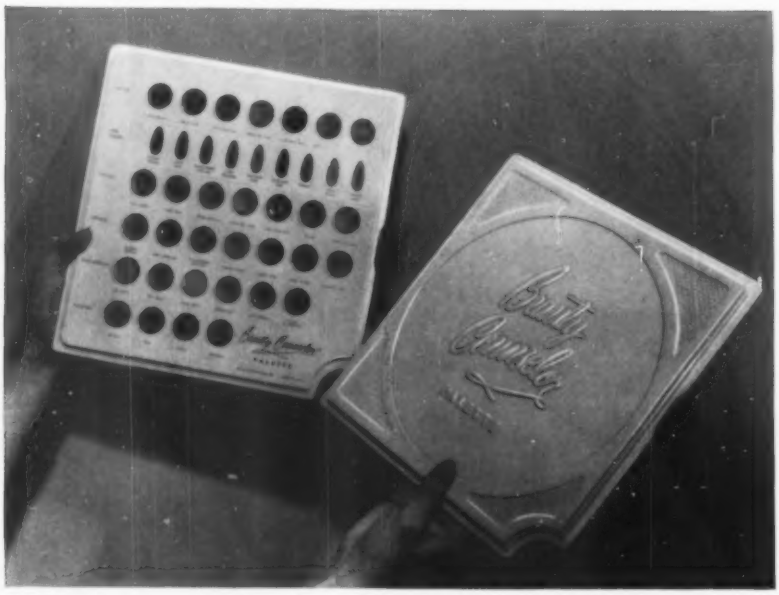
AMOCO CHEMICALS

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CAMPCO PROGRESS

latest developments in plastic sheet · film · fabrication

New make-up demonstrator of Campco Styrene helps Beauty Counselor sales



Salespeople for Beauty Counselor products, who call at the homes of their customers and prospects, can now let them "select and try before they buy." This attractive Palette, which is a part of the full-line sales kit, contains samples of all 31 shades of Beauty Counselor lipstick, rouge, nail polish, eye shadow and mascara. Each is plainly identified by name and color so the customer can easily and quickly determine which shade is best suited to her needs. The tightly fitting cover, embossed with the Beauty Counselor name, protects the samples.

This effective sales tool is produced by Paper Package Company of Indianapolis, Indiana for Beauty Counselors, Inc., of Detroit, Michigan. The material used is Campco S-540 Styrene sheet, .030 gage, GM finish. This material was selected because of its sparkling, porcelain-like finish, excellent formability, uniformity, and resistance to cracking. The smooth, brilliant surface insures fine silk screening.

This Palette is pressure-formed. The sheet is heated slightly and then formed in a single-cavity male and female matched die to get a sharp radius. The sheet is trimmed at the same time, eliminating a second operation.

Campco S-540 has proved particularly successful in the production of hundreds of hot-formed and vacuum-formed items. Its surface is such that excellent results can be expected from letterpress, offset or silk screen printing. Decal transfers are also easily applied. This sheet is available in a full range of colors as well as translucent and opaque from .01" to .187" thick, stock and custom sheets.

Campco Styrene gives long life to these trays

Photo developing trays are subject to considerable abuse due to their daily contact with water and various chemicals, as well as rough handling.

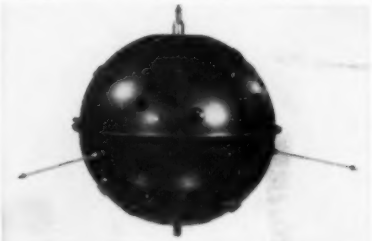
Campco High Impact Styrene has proved particularly successful in the production of these "Zephyrlite" trays. They are made and sold by Mills Affiliates of Kansas City, Missouri. This tough sheet is easily formable, yet has a fine smooth, white surface which is easy to keep clean. It is highly acid-resistant and shatter-proof. In fact, so durable are these trays that they are sold on a money-back guarantee if broken under normal use.



Unique revolving "Spots-Lite" stimulates entertainment business

If you walk into a tavern, dance hall or roller skating rink and see sparkling colored lights playing on walls and ceiling, chances are they're coming from a Hollywood Spots-Lite.

This unique device has proved to be a great business builder in hundreds of places of entertainment. The large globe is set with dozens of colored lenses and as it slowly revolves, beams of colored light move slowly around the room adding glamour and gaiety to the scene.



The globe itself, which measures 18 inches in diameter, is vacuum formed by Omaha Plastic Company for Hollywood Spots-Lite Company of Omaha, Nebraska. It is vacuum-formed in two halves from Campco Woodgrain finish plastic sheet. This rubber modified Styrene sheet has the appearance of fine wood and is light in weight. It has all the desired characteristics of standard Campco sheet including high impact resistance, dimensional stability and excellent formability. It is available in cut-to-size and standard sheets from .040" to .187" thick.

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CAMPCO Sheet and Film, **a Division of Chicago Molded Products Corp.**

January 1960, Volume 37, Number 5

MODERN PLASTICS

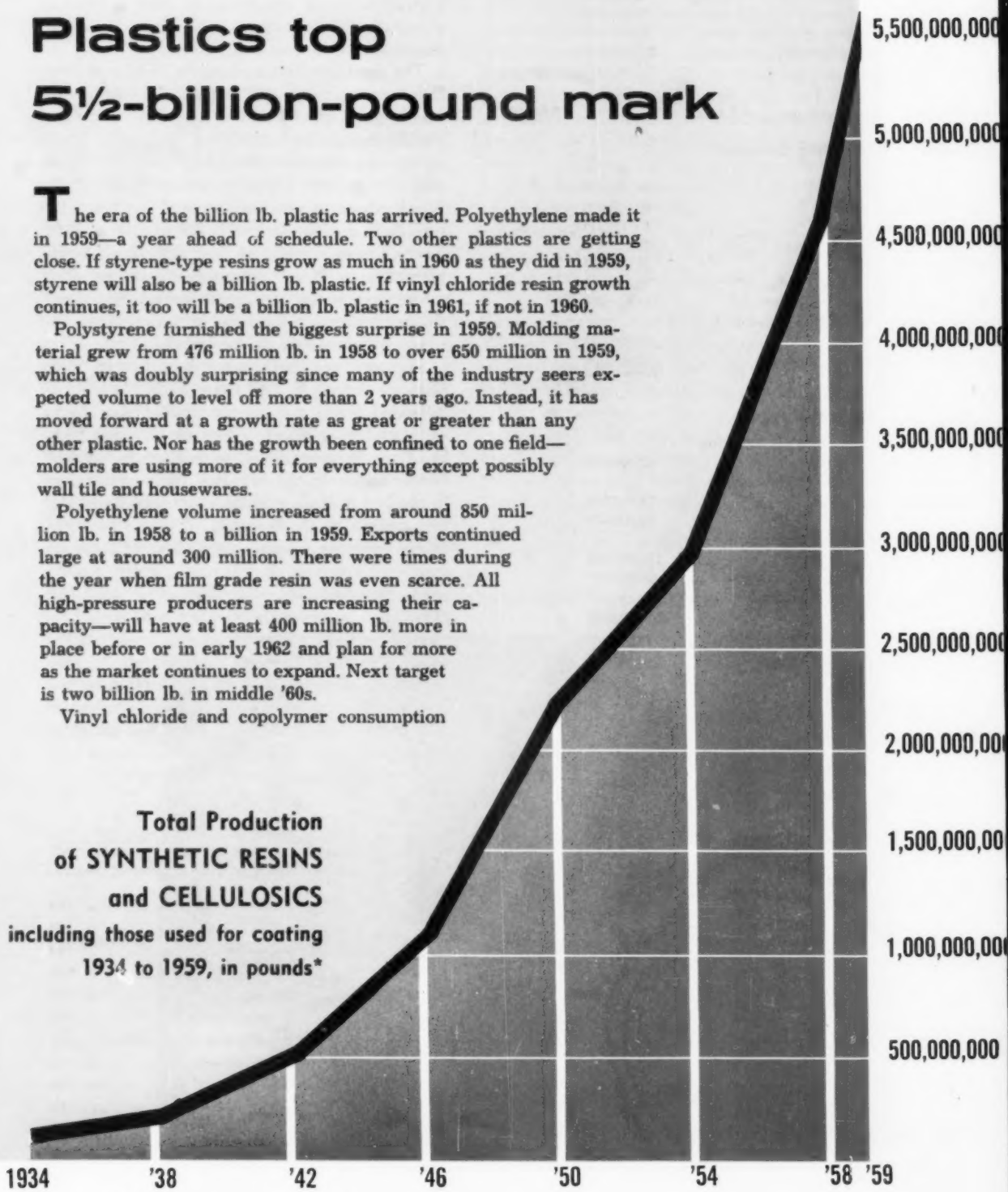
Plastics top 5½-billion-pound mark

The era of the billion lb. plastic has arrived. Polyethylene made it in 1959—a year ahead of schedule. Two other plastics are getting close. If styrene-type resins grow as much in 1960 as they did in 1959, styrene will also be a billion lb. plastic. If vinyl chloride resin growth continues, it too will be a billion lb. plastic in 1961, if not in 1960.

Polystyrene furnished the biggest surprise in 1959. Molding material grew from 476 million lb. in 1958 to over 650 million in 1959, which was doubly surprising since many of the industry seers expected volume to level off more than 2 years ago. Instead, it has moved forward at a growth rate as great or greater than any other plastic. Nor has the growth been confined to one field—molders are using more of it for everything except possibly wall tile and housewares.

Polyethylene volume increased from around 850 million lb. in 1958 to a billion in 1959. Exports continued large at around 300 million. There were times during the year when film grade resin was even scarce. All high-pressure producers are increasing their capacity—will have at least 400 million lb. more in place before or in early 1962 and plan for more as the market continues to expand. Next target is two billion lb. in middle '60s.

Vinyl chloride and copolymer consumption



*Source: U.S. Tariff Commission and Modern Plastics Estimates

Consumption in pounds of synthetic resins and cellulosics, including surface coatings, in 1959[a]

Cellulose plastics		
Cellulose acetate and mixed esters		
Continuous sheets under 0.003 gage	19,000,000	
Continuous sheets 0.003 gage and over	20,500,000	
All other sheets, rods, and tubes	10,500,000	
Molding and extrusion materials	102,000,000	
TOTAL		152,000,000
Nitrocellulose sheets, rods, and tubes		2,400,000
Phenolic and other tar-acid resins[b]		
Molding materials	218,000,000	
Laminating resins	80,000,000	
Abrasives	16,000,000	
Friction materials, brake linings	15,000,000	
Plywood	56,000,000	
Thermal insulation binder	58,000,000	
All other bonding resins	62,000,000	
Protective coatings, modified and unmodified	57,000,000	
Miscellaneous	42,000,000	
TOTAL		604,000,000
Urea and melamine resins		
Textile-treating and textile-coating resins	42,000,000	
Paper-treating and paper-coating resins	26,000,000	
Laminating	29,000,000	
Bonding and adhesive resins for plywood	111,000,000	
All other bonding and adhesive uses	19,000,000	
Protective coating resins, straight and modified	29,000,000	
Resins for all other uses, including molding	128,000,000	
TOTAL		384,000,000
Vinyl chloride		828,000,000
Other vinyls including acetate, saran, butyral, etc.		232,000,000
Styrene-type resins		
Molding materials	665,000,000	
Other types, coatings, etc.	225,000,000	
TOTAL		890,000,000
Alkyd and rosin modified coatings except phenolics[b]		585,000,000
Coumarone-indene and petroleum polymer resins		285,000,000
Polyesters		140,000,000
Polyethylene		1,080,000,000
Epoxies		45,000,000
Miscellaneous		210,000,000
GRAND TOTAL		5,437,400,000

[a] Source: U. S. Tariff Commission, first 8 months; last 4 months estimated.
[b] Production figures used for all phenolics and alkyds because of large proportion of captive plants.

leaped to approximately 830 million lb. in 1959, compared with about 650 million in 1958. There had been almost no growth in 1958 over '57. Large volume use in the automotive and housing industries helped, but here again there were large-volume increases in nearly every field. Considerably greater use of calendering resins was particularly encouraging, since growth in this area of the plastics industry had been slowing down in the last few years.

The startling rise in phenolic resin consumption was as unexpected as the polystyrene situation—great growth in a material that some people thought had stabilized. And again it was across the board—everything grew. The outstanding growth, however, was in molding material where production zoomed up from 168 million lb. in 1958 to nearly 220 million in 1959. There are still areas of new growth in liquid phenolics, such as decorative laminates, shell molding, and wood waste bonding that make this an attractive field for speculation on the future potential of the material.

Prospects are that there will be just as much or more growth in 1960 than there was in 1959, provided there are no economic disturbances of devastating effect. Huge inventories were built up in early 1959, which made sales of resins higher in the first half of the year than in the last half. In normal years, last half sales are generally the largest. There was some worry over the possible later effect of these inventories, since much of it was in finished parts used by appliance manufacturers, but this cloud has supposedly cleared up and 1960 started without this surplus. The predicted small decline of 100,000 new homes in 1960 should be offset in plastics consumption by the rise in automotive uses. But high interest rates and threatened strikes of extended duration could hurt all business and plastics would certainly suffer along with other industry.

Full discussion on specific materials will be found on the following pages:

Cellulosics ..... p. 104
Delrin ..... p. 108
Melamine ..... p. 111
Methacrylate ..... p. 106
Nylon ..... p. 107
Phenolics ..... p. 109
Polyethylene ..... p. 91
Polypropylene ..... p. 96
Polystyrene ..... p. 100
Polyvinyl chloride ..... p. 97
Urea ..... p. 111

MARKETS FOR MATERIALS — 1959



POLYOLEFINS

Polyethylene reached a volume of approximately a billion lb. in 1959, compared with around 850 in 1958. Of this total, 80 million lb. was low-pressure processed. Film grade resin was the largest classification, with a total estimated at from 310 to 330 million pounds. Polypropylene now in commercial production by two companies . . . principal use now is molding . . . fiber and film to follow.

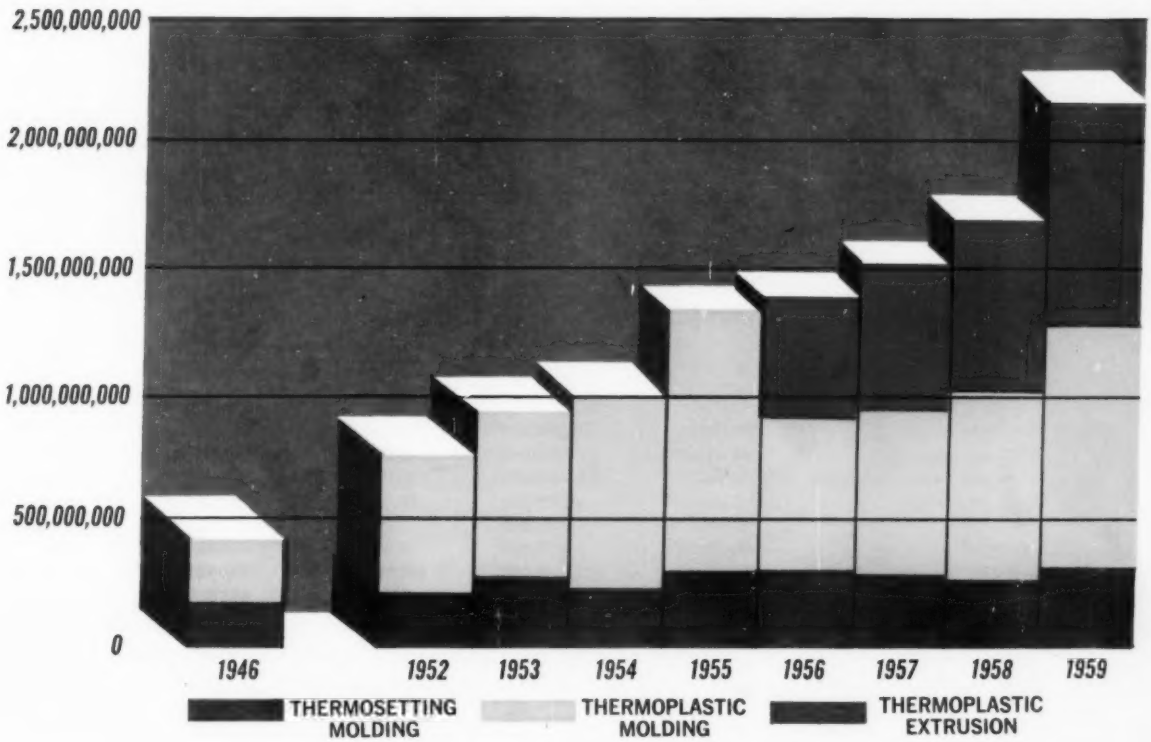
Polyethylene

The first billion lb. plastic, polyethylene, came in a year ahead of schedule. In May the high-pressure-process part of the industry produced resin at a 1.1-billion-lb. rate for a record month. Additional capacity has been added since that time. Low-pressure producers were operating at around a 100-million-lb./yr. rate in the latter part of 1959; they were going at around 50 to 60 million/yr. in the earlier months. The total of all polyethylene for 1959 is somewhat clouded at this writing, since November and December showed signs of a slight decline; but the total should end up in the neighborhood of 1.1 billion.

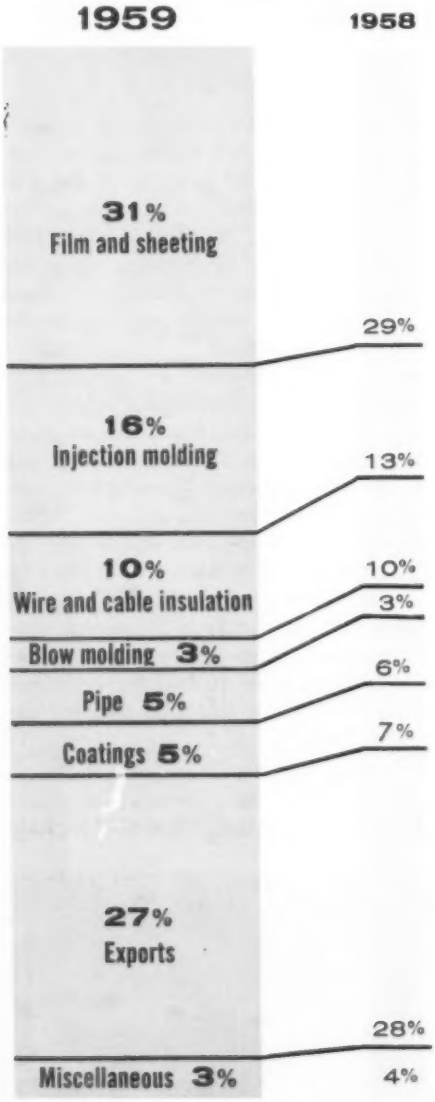
Estimated use of low-pressure-processed or linear (high-density) polyethylene, which is a part of the 1.1 billion lb., was from 80 to 85 million and this includes off-grade, export, and the amount used in blending. There is no unanimity on how it is divided into end uses, but a composite of various opinions would provide the distribution shown in the table on page 94.

No two persons will agree on all the figures in this table but they at least represent what the low-pressure processors are shooting at—by 1962 they may have quite different ideas. The film and sheet, and injection molding fig-

Sales of molding and extrusion materials in pounds, 1946 through 1959



Estimated polyethylene consumption by end products



ures for 1962 look especially optimistic. The high film figure is no doubt based on the hoped-for success of copolymer and blended resins, the use of sheet for vacuum forming, adoption of the 5- or 6-mil bag for shipment of such things as fertilizer, and film for flat wrapping. Injection molding optimism comes from a belief that high-density resin will cut deeply into conventional polyethylene, and will hold its own against polypropylene. The sheet figure is based on a belief that thermoforming of polyethylene will be perfected. The blow-molding figure is large because the industry expects that detergent bottles plus many others will all be in high-density by 1962.

The reader will note that the low-pressure resin total expected for 1962 equals just about capacity at the beginning of 1960. However, the new Du Pont and extended Allied facilities are not yet in commercial production, and several other companies are still considering the move to low-pressure production—it wouldn't be surprising to see 100 million lb. or more of capacity added by 1962.

Other factors related to this situation are the practice of blending high- and low-pressure resin, development of copolymers, and use of special catalysts that make it possible to increase the density of high-pressure polyethylene. Both high- and low-pressure producers are now making a 0.940-density resin which would normally be classified as a low-pressure resin but which contains more high-pressure resin than it does low-pressure resin.

There are various ways of reaching this 0.940 density point. The low-pressure producers can do it by blending high- and low-pressure resins or by copolymerization with another suitable monomer. The high-pressure

Estimated consumption of polyethylene, by end uses[a, b]

End Use	*1955* lb.	*1956* lb.	*1957* lb.	*1958* lb.	*1959* lb.
Film and sheeting	120,000,000	160,000,000	205,000,000	245,000,000	320,000,000
Injection molding	45,000,000	50,000,000	80,000,000	120,000,000	170,000,000
Wire and cable insulation	45,000,000	58,000,000	75,000,000	87,000,000	105,000,000
Blow molding[c]	9,000,000	15,000,000	20,000,000	28,000,000	38,000,000
Pipe	26,000,000	35,000,000	50,000,000	55,000,000	62,000,000
Coatings[d]	30,000,000	30,000,000	35,000,000	40,000,000	50,000,000
Exports	65,000,000	125,000,000	190,000,000	235,000,000	295,000,000
Miscellaneous	10,000,000	41,000,000	7,000,000	44,000,000	40,000,000
TOTAL	350,000,000	514,000,000	662,000,000	854,000,000	1,080,000,000

[a] These figures do *not* include reprocessed material that is used in pipe, molding material, black film, or exports, but they *do include* off-grade resins which are reported by suppliers as virgin material. Some of the off-grade is reported in miscellaneous. [b] Total figures are based on Tariff Commission reports, except 1959, which is estimated. All other figures are MODERN PLASTICS estimates. [c] Includes bottles, jars, tubes, carboys, and toys—the latter estimated at 6 million. [d] Includes low molecular weight polyethylene (wax) used for coatings.

producer can, likewise, blend or he can use a special catalyst or perform other tricks of polymerization. However, polymerization costs more than blending. Thus, even though a polymerized product may have somewhat better properties it is often more practical to produce the material as a blend.

In addition to what resin producers may do to arrive at a resin in this middle ground, the molders and compounders also have a system —they buy both low- and high-density resins, often off-grade, and blend it themselves. Thus a good hunk of the resin shown in this table is used for blending a material that is a cross between low- and high-pressure resin.

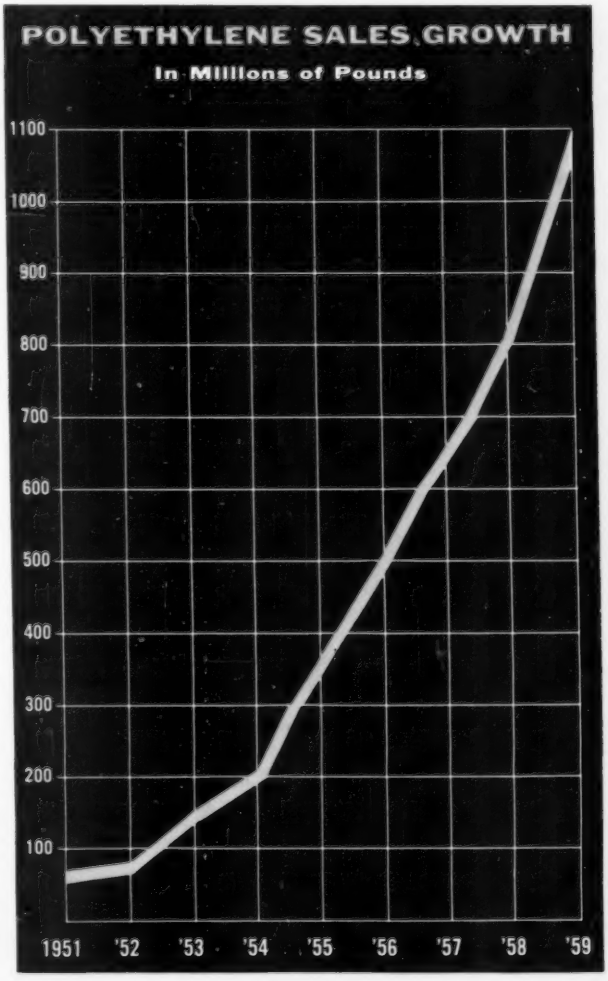
The purpose, of course, is to get certain properties that are not obtainable in the lower and higher density resins. For film, the user wants more stiffness than he can get from low density but more branching of the polymer than in straight linear or high-density, so that the film can be handled easier. The molder of housewares is after more stiffness and a glossier, harder surface. This situation is going to complicate the polyethylene business more than ever, but it may eventually force a simplified nomenclature and make such terms as high-pressure, low-pressure, linear, branched, etc., unnecessary. There will be only the designation "polyethylene" with a number attached and the customer will learn which number is the one he wants for a specific application.

In the meantime, Union Carbide is still the largest producer with an announced capacity of 320 million lb. of high-pressure resin and an announcement of 25 million more within a short time. A recent press release states that Carbide's expansion plans will give them an eventual capacity of 600 million lb., including 55 million for low-pressure PE. Du Pont is now around 200—will soon expand by perhaps 50 percent. U.S.I. has 300 million committed by mid-1961 and is thought to have plans for quick expansion if the market is ready. So far they are the three leaders. Practically every high-pressure producer is expanding. There is thought to be around 400 million lb. of new capacity now a-building which will be ready in or before 1962. Added to the industry's present approximately 1.2 billion lb., that's a lot of capacity. There will also probably be at least 400 million lb. of low-pressure resin capacity in the U. S. Added to the estimated 800 million of high-pressure capacity abroad, that's a right healthy figure.

The industry has been growing at a rate of more than 150 million lb./yr. Thus the 400 million lb. new capacity is expected to easily take care of demand. It should be kept in mind that there is also a planned 100 million more of low-pressure capacity, in addition to the 200 or so million which hasn't been used to date. Finally,

POLYETHYLENE FOR COATING (lb.)

	1957	1958	1959
Paper & paper board	15,000,000	19,000,000	24,000,000
Cellophane and Mylar	5,000,000	7,000,000	10,000,000
Foil	6,000,000	4,000,000	4,000,000
Wax	7,000,000	9,000,000	11,000,000
Miscellaneous	1,000,000	1,000,000	1,000,000
TOTAL	34,000,000	40,000,000	50,000,000



LOW-PRESSURE (linear) POLYETHYLENE CONSUMPTION

millions of lb.

Use	1959 million lb.	1960 million lb.	1962 million lb.
Film	4	12	25
Sheet	2	5	18
Injection molding	35	60	150
Wire and cable	1	3	14
Filament	4	3	2
Pipe and conduit	9	15	35
Paper coating	0	2	6
Blow molding	6	20	50
Export	18	15	15
Miscellaneous[a]	4	10	10
TOTAL	83	145	325

[a] Miscellaneous includes such things as profile extrusions like gasketing, industrial molding not otherwise classified, foam, and other unidentified items.

expansion of overseas facilities may cut into an export market of some 300 million pounds.

The separation into end uses of polyethylene as shown in the Table on p. 92 becomes more complex every year. The total figure is fairly well established by the monthly Tariff Commission reports, but the separation into various end uses is obtained by personal interviews with sales and market research departments of the various resin suppliers. Their opinions were more varied this year than ever before, but this is to be expected in an industry that is spreading out into so many directions.

Among the troublesome factors in estimating amount of resin used for each end use is off-grade material. It is reported as virgin material by the producer and in many cases is quite satisfactory. It may be off-color or have other blemishes or not meet the requirements of the particular job for which it was ordered but be suitable for others. There may be as much as 100 million lb. of this stuff around the country. Producers sell most of it to compounders who mix it with first grade resin, carbon black, and other materials and tailor it to meet the specific needs of their customers. In general it has no heat history. Such compounded material is used chiefly for injection molding, pipe, and black film or sheet. It is not to be confused with scrap material which is generally made up of trim, sprue, and rejects.

This off-grade material is often reported by the producer in the "all other uses" or miscellaneous section, of the table on p. 92. But in this report, an effort has been made to allocate as much as possible of this off-grade to its actual use. This accounts for the large volume in injection molding and pipe. Well over 20% of the resin in these categories is estimated to be off-grade. At least 10 million more should be added to pipe and an unknown quantity to injection molding to account for the scrap (sprue, etc.) that is used by extruders and molders if one wished to know the total volume of "put-through" in these two categories.

The reader will note in the low-pressure table, above, that injection molding of low-pressure, high-density material was by far the leading outlet; and a great part of this volume is in housewares. In 1960 there should be a big increase in this application, now that molds and patterns have been made. Some of the older housewares molding firms have held back with complaints about nonuniformity of material, performance, and processing problems. But these same old complaints always turn up whenever a new plastic is introduced and they are generally overcome by experience.

At the last Housewares Show, a major molder said: "I am changing over to high-density in as many items as possible as soon as possible." Many others will soon be following his example. They like the stiffness, hard, glossy surface, and higher heat resistance of higher-density resins. They are (To page 96)

CONSUMER USES OF POLYETHYLENE FILM

	1958 million lb.	1959 million lb.	1963 million lb.
Packaging	180	230	425[a]
Drapes, tablecloths	10	12	15
Construction industry	20	25	35
Rubber industry	7	8	8
Agriculture industry	9	8	20
Miscellaneous	19	27	37
TOTAL	245	310	540

[a] This is pure guess based on a film growth of 50 or 60 million lb./yr. through 1963, but gives an idea of trends as seen today. The total may be larger if flat wrapping, including bread wraps, takes over the market expected by some analysts, but there may also be deterrents, such as slow development of machines to handle the film and competition from other types of film, paper, coated stock, and other materials.

A rough guess at a separation of the 1963 packaging category would be 58% for produce; 15% for bakery goods; 18% for textiles and paper goods; 7% for garment bags.

PRICE HISTORY OF PLASTICS MATERIALS

ACETATE

YEAR	PRICE $/lb.		
	Group I	Group II	Group III
1948	0.47	0.42	0.33
1949	0.47	0.42	0.35
1950	0.49	0.43	0.37
1951	0.57	0.50	0.42
1952	0.57	0.50	0.42
1953	0.50	0.46	0.42
1954	0.50	0.46	0.42
1955	0.50	0.46	0.36
1956	0.50	0.46	0.36
1957	0.50	0.46	0.38
1958	0.52	0.48	0.40

ABS

Year	Price $/lb.
1954	0.70
1955	0.65
1957	058†

†Compounded. Straight resin is 53¢

BUTYRATE

YEAR	PRICE $/lb.
1938	0.70
1939	0.54
1940	0.49
1944	0.44
1946	0.56
1949	0.51
1950	0.62

DIALLYL PHTHALATE

Year	Price $/lb.
1956	0.85

EPOXY

YEAR	PRICE $/lb.
1953	1.00
1954	1.00
1955	0.80
1956	0.80
1957	0.80
1958	0.62

MELAMINE

YEAR	PRICE $/lb.
1947	0.45
1948	0.48
1950	0.45
1956	0.45
1957	0.47

METHA-CRYLATE

YEAR	PRICE $/lb.
1937	0.85
1947	0.70
1954	0.68
1955	0.59
1956	0.55

MYLAR

YEAR	PRICE $/lb.
1951	3.00
1954	2.85
1955	2.50
1956	2.25
1957	2.00
1958	1.80

NYLON

YEAR	PRICE $/lb.
1944	1.60
1955	1.435
1956	1.33
1957	1.18

PENTON

YEAR	PRICE $/lb.
1956	6.00
1959	3.50

PHENOLIC

YEAR	PRICE $/lb.
1925	0.60
1931	0.22
1933	0.14
1941	0.155
1943	0.135
1946	0.155
1947	0.165
1948	0.172
1949	0.167
1950	0.197
1954	0.187
1955	0.192
1956	0.202
1957	0.212
1958	0.192

POLYETHYLENE

YEAR	L-D PRICE $/lb.	H-D PRICE $/lb.
1943	1.00	
1945	0.70	
1946	0.52	
1947	0.47	
1948	0.43	
1950	0.45	
1951	0.48	
1952	0.47	
1953	0.47	
1954	0.41	
1955	0.41	
1956	0.41	
1957	0.35	0.47
1958	0.35	0.43
1959	0.32½	0.35

*Last figure in column is current price in late 1959. Only years given when price change is made, except phenolic, which skips several years in the late 1920's when prices were declining. Prices are based on lowest quotation for quantity lots. When comparing prices of one plastic with another, reader must consider specific gravity.

More prices on p. 96 →

POLYPROPYLENE

YEAR	PRICE $/lb.
1957	0.65
1958	0.56
1958	0.49
1959	0.42

POLYSTYRENE

(General Purpose)

YEAR	PRICE $/lb.	BASE POUNDS
1938	0.68	
1939	0.57	
1940	0.52	
1942	0.29	
1944	0.27	
1946	0.26	
1947	0.25	30,000
1948	0.27	30,000
1949	0.255	50,000
1949	0.255	30,000
1950	0.27	30,000
1950	0.305	Any Quantity
1951	0.325	Any Quantity
1954	0.325	20,000
1954	0.315	40,000
1954	0.305	20,000
1955	0.295	20,000
1955	0.29	80,000
1956	0.305	80,000
1956	0.275	20,000
1957	0.26	20,000
1957	0.25	20,000
1958	0.2425	20,000
1959	0.215	20,000

POLYSTYRENE

High Impact
*Natural

YEAR	PRICE $/lb.	BASE POUNDS
1949	0.38	50,000
1950	0.395	50,000
1950	0.415	50,000
1952	0.41	50,000
1953	0.37	Any Quantity
1953	0.34	Any Quantity
1954	0.34	20,000
1954	0.33	20,000
1955	0.315	80,000
1956	0.33	80,000
1956	0.32	20,000
1959	0.31	20,000
1959	0.285	20,000

* Offered in color only—through 1952

Price History *(Cont'd from p. 95)*

POLYVINYL CHLORIDE

YEAR	PRICE $/lb.
1934	0.78
1935	0.59
1937	0.56
1940	0.52
1942	0.48
1943	0.44
1944	0.39
1945	0.35
1946	0.33
1948	0.34
1950	0.36
1951	0.38
1954	0.37
1955	0.35
1956	0.32
1957	0.30
1958	0.235

PROPIONATE

YEAR	PRICE $/lb.
1956	0.62

SARAN

YEAR	PRICE $/lb.	BASE POUNDS
1939	1.25	
1939	0.75	
1940	0.70	
1940	0.59	
1940	0.54	
1941	0.53	
1944	0.45	
1945	0.40	
1947	0.35	30,000
1950	0.39	
1952	0.39	20,000

STYRENE/ACRYLONITRILE

YEAR	PRICE $/lb.	BASE POUNDS
1955	0.41	80,000
1957	0.405	80,000

TEFLON

YEAR	PRICE $/lb.
1944	15.00
1948	9.00
1949	7.50
1950	5.50
1954	5.10
1955	4.90
1956	4.50
1959	3.65

UREA

YEAR	PRICE $/lb.
1944	0.22
1947	0.29
1948	0.30
1949	0.31
1950	0.33
1957	0.34

VINYL PASTE RESIN

YEAR	PRICE $/lb.
1947	0.40
1950	0.37
1950	0.39
1955	0.34
1956	0.30
1958	0.28
1958	0.265

learning how to control variations in shrinkage, warping and stress cracking by multiple gating and heat control. They are also cognizant of a price drop in 1959 of from 42 to 35¢; but costs fluctuate all over the lot in this category anyhow because of the great quantities of off-grade and blended resins in use.

A great part of the compound (To page 184)

Polypropylene

Polypropylene sales volume began to pick up early in 1959 and had gained considerable momentum by the end of the year. Hercules Powder Co., the first producer in the United States, reported capacity operation for the last quarter. AviSun, a joint company set up by Sun Oil and Avisco, started production in late August.

Various other companies have announced their intentions to enter the field. Montecatini stated that their previously announced plant's capacity would be raised to 25 million pounds. Enjay and Spencer Chemical will handle the distribution of Humble Oil Co.'s plant, listed at 50 million lb. capacity with material available for distribution in January or February of 1960. Texas-Eastman is turning out polypropylene on a "limited basis." Dow Chemical Co. has announced plans for construction of two plants. Firestone has stated that the company has plans to build a facility at Hopewell, Va. Most of these companies are expected to have large commercial quantities available in 1960 or 1961.

Total capacity of all these plants is pure guesswork at this time and would be subject to immediate change anyhow as each of them is probably planning expansion. Other firms may also enter the field. It wouldn't be at all impossible to have a 500-million-lb. capacity by the end of 1963. Hercules spokesmen have predicted a billion lb. sales volume sometime in the mid-1960's.

The price of polypropylene is now 42¢/lb.—a drop from 49¢ in 1958. The monomer, propylene, is around the same cost as ethylene so the reader can use his own judgment on the future price structure.

Hercules, the first entrant in the field, has announced planned capacity of 150 million lb. and expects to keep ahead of the pack in volume production. The first plant was announced as 20 million lb. capacity in November, 1957 at the Parlin, N. J. installation where Ziegler-type polyethylene was also produced. This plant is to be expanded to exceed 50 mil-

lion lb., but how much of each material is to be produced will probably depend upon the market. The first 50-million-lb. unit of the new 100-million-lb. plant is scheduled for early 1961. Hercules has been careful to state that plans for the new plant call for "in excess of 100 million lb. a year." The probabilities are that every company so far involved has made plans for fast expansion to take care of an expected rapidly expanding market in the coming year.

The largest volume of poly- (To page 192)



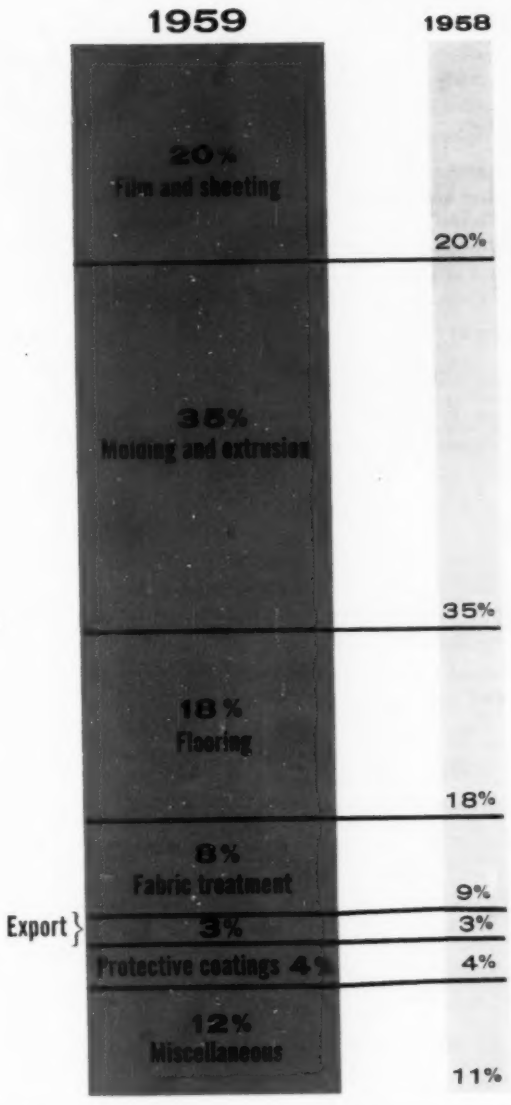
VINYL CHLORIDE

Vinyl chloride resins are now well over 800 million lb . . . should go over 900 in 1960 . . . would have been larger in 1959 except for shortage of plasticizer and slow-down in automotive . . . calendering resins grew, partly because of increasing use of laminates . . . floor covering is big, may grow to 250 million lb. in few years. Plastisols continue growth . . . rigid vinyls begin to stir more vigorously.

Any man who in 1958 predicted that vinyl chloride resin would grow by 180 million lb. in 1959 would have been ranked as a character almost comparable to a politician who promises to eliminate death and taxes.

There were eager optimists who predicted an 80-million-lb. increase, but even they were regarded as odd by the more conservative brethren. After all, 1958 had shown almost no

Consumption of polyvinyl chloride and copolymers



Polyvinyl chloride and copolymer consumption, 1955-1959[a]

Use	*1955* lb.	*1956* lb.	*1957* lb.	*1958* lb.	*1959* lb.
Film under 10 mils	83,000,000	78,000,000	78,000,000	74,000,000	86,000,000
Sheeting 10 mils and over	51,000,000	53,000,000	80,000,000	74,000,000	87,000,000
Fabric treatment[b]	56,000,000	55,000,000	55,000,000	55,000,000	70,000,000
Paper treatment	8,000,000	8,000,000	10,000,000	9,000,000	10,000,000
Floor coverings	56,000,000	66,000,000	82,000,000	116,000,000	157,000,000
Molding and extrusion	183,000,000	205,000,000	220,000,000	224,000,000	290,000,000
Protective coatings	26,000,000	29,000,000	32,000,000	27,000,000	31,000,000
All other uses[c]	58,000,000	74,000,000	78,000,000	70,000,000	97,000,000
TOTAL	521,000,000	568,000,000	635,000,000	649,000,000	828,000,000

[a] Source: U. S. Tariff Commission, with estimated alterations due to more varied breakdown. [b] Resin used for laminates with fabric is included in film figure rather than in fabric treatment. [c] Includes export, some off-grade and various other uses not included in other classifications. NOTE: Film and sheet resins are impossible to separate accurately but the total of the two as given above is thought to represent a reasonably reliable figure on total amount of resin used for both.

VINYL CHLORIDE FOR MOLDING AND EXTRUSION

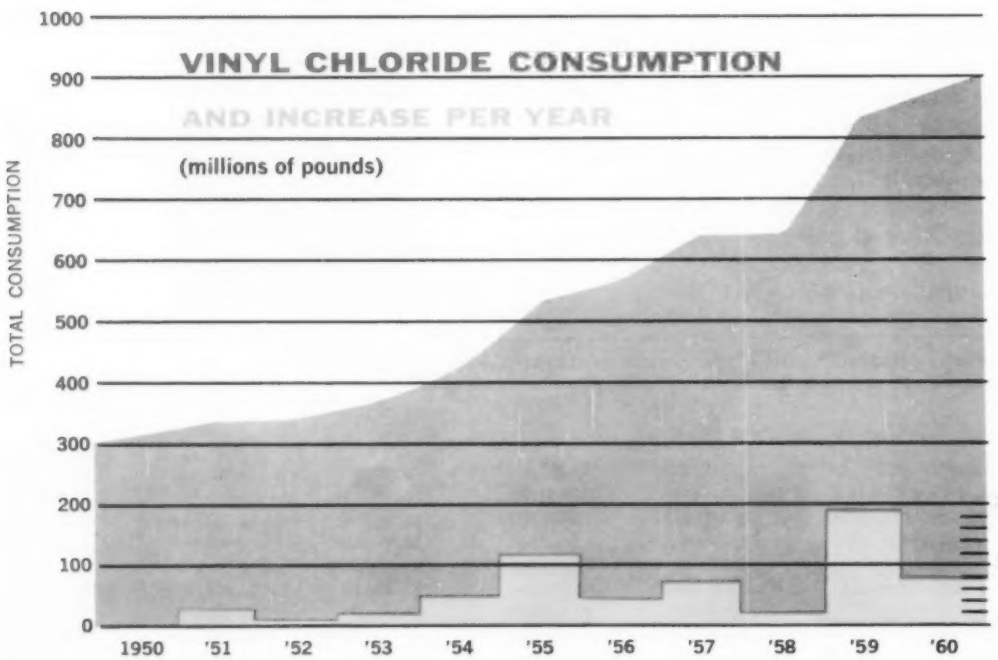
Application	1958 lb.	1959 lb.
Phonograph records	38,000,000	43,000,000
Slush and elastomeric molding	37,000,000	54,000,000
Profiles	32,000,000	46,000,000
Wire coating	85,000,000	96,000,000
Rigid pipe and shapes	11,000,000	18,000,000
Garden hose[a]	17,000,000	24,000,000
Miscellaneous	5,000,000	5,000,000
Foam and sponge	—	4,000,000
TOTAL	**225,000,000**	**290,000,000**

[a] A large portion of garden hose is produced from off-grade resin. It is reported here as virgin resin—although it is generally sold to compounders and reported to the Tariff Commission as "all other resins." There is also a good quantity of scrap resin used in garden hose, but that material is not reported in this table.

growth and the faint-hearted became more faint as they foresaw a leveling-off that would put the kibosh on plans for expansion. A 180-million-lb. (90,000-ton) growth for a 600-million-lb. product is something that doesn't happen very often in the plastics industry, especially to a product that has been well established for 10 years.

The growth in 1959 as shown in the graph below is considerably greater than in any other year. The total as shown in the table on p. 97 may even be under the final Tariff Commission figures, since a liberal allowance has been made for a decline in sales during the months of November and December. From March through September the industry was operating at a monthly rate of from 70 to 76 million lb., but part of this may be accounted for by inventory build-up in anticipation of shortages caused by the steel strike. If the Tariff Commission's first 6 month's consumption figures were doubled, the total for 1959 would be 842 million pounds. In fact, the Commission's figures are so high that some analysts fear that there may have been some errors in companies' reports that were filed with the government which will have to be corrected later. On the other hand nearly every producer reports the "best year ever" with production at near capacity level.

The probabilities are that the total might have reached 850 million lb. if it had not been for the steel and copper strikes. These strikes interfered with auto and wire coating production. There was also a shortage of DOP plasticizer because of a scarcity of phthalic anhydride.



The importation of vinyl chloride resin is no longer an important factor in the business. It was about 15.5 million in 1958, with 9 coming from Italy; 5 from Japan; and small amounts from other countries, mostly Canada. Imports in 1959 are estimated at about 12 million, with over 7 from Italy, and not much over 2 from Japan. Since the price of American resin has dropped to 23½¢/lb., there has been a decline in use of foreign resin. But if this 12-million-import is added to domestic consumption, the total of all vinyl chloride used in the United States would be over 840 million pounds.

However, there is a disturbing angle involved in the import situation. The quantity of imported finished goods such as vinyl raincoats, footwear, baby pants, and floor covering, is growing at a rapid rate. This will, of course, eventually affect the amount of resin sold in this country.

The automotive industry has played an interesting part in vinyl chloride history. Use per car has grown from 4 or 5 lb. in the mid-50's to an estimated 10 or 12 today. If the figures are true, passenger cars used between 55 and 60 million lb. of vinyl chloride in 1959, compared with 45 to 48 million in 1958.

It can be seen that although automotive use is an important factor in vinyl consumption its importance as a bellwether is over-rated. That 50 million or more lb. volume is significant, but the drop or rise of car production by 1 or 2 million cars affects the total industry by only 10 to 25 million pound. Of course, this is mighty important for the calendering section of the industry and extruders of wire coating and welting are deeply involved. But resin producers are essentially far more dependent upon a broad cross-section of all industry than they are upon a concentration in the automotive field.

Reasons for the mountainous growth in 1959 cannot be pinned to any one end use. Everything grew. Some analysts attempt to credit the price drop of from 30¢ to 23½¢ for the triggering factor, but producers are inclined to believe that volume would have been almost as large even at the old price. They point out that it requires at least a year for the effect of a price drop to open new markets or even to vastly increase old ones. Therefore, the low price will have more effect in 1960.

Largest volume growth among the listed end products in 1959 was 66 million lb. for molding and extrusion and 41 million for flooring. Together they account for the bulk of growth.

Future areas of expansion which are ex-

PATTERN OF CONSUMPTION OF CALENDERED VINYL FILM*

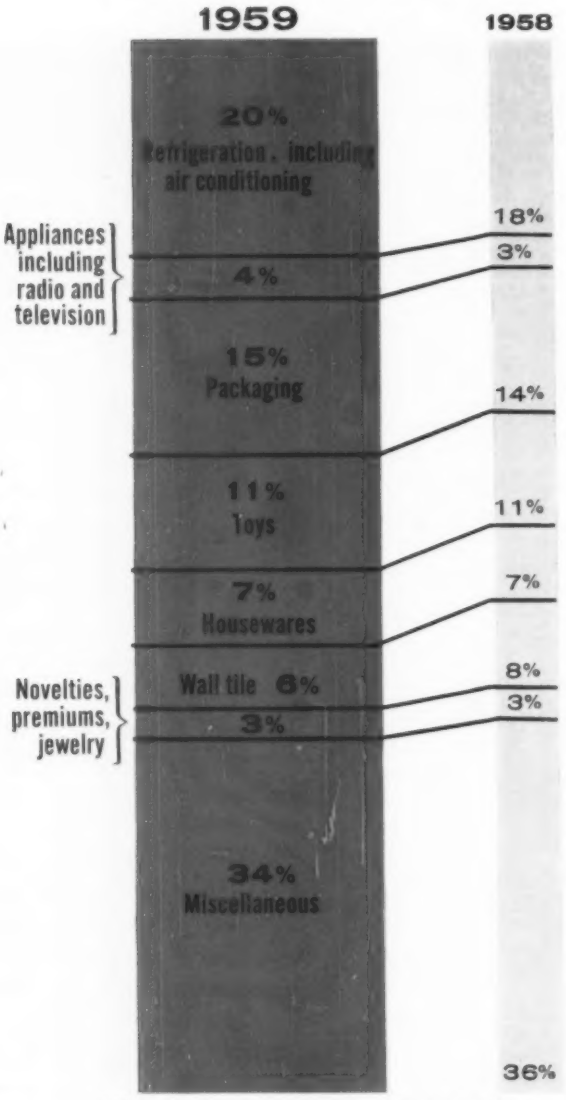
Uses	1953 lb.	1958 lb.	1959 lb.
Draperies, bedspreads, kitchen and bathroom curtains	23,000,000	13,500,000	**13,500,000**
Yard goods	10,000,000	4,000,000	**3,000,000**
Adhesive-backed film	—	5,500,000	**7,000,000**
Closet accessories	6,500,000	6,900,000	**7,500,000**
Shower curtains[b]	6,000,000	9,200,000	**11,000,000**
Nursery goods	4,000,000	3,800,000	**3,200,000**
Baby pants, liners[b]	2,400,000	6,000,000	**6,500,000**
Table covers	4,000,000	3,000,000	**2,500,000**
Appliance covers	3,000,000	2,100,000	**3,500,000**
Furniture covers, indoor and outdoor	3,000,000	4,700,000	**6,500,000**
Rainwear and sportswear	10,000,000	11,000,000	**7,000,000**
Aprons, including industrial	1,500,000	1,800,000	**2,000,000**
Lamination, quilting	—	11,500,000	**18,000,000**
Wall covering	—	2,500,000	**1,500,000**
Industrial tape	—	6,000,000	**8,000,000**
Inflatables	—	7,500,000	**12,000,000**
Industrial, agricultural, and miscellaneous	20,000,000	21,000,000	**27,300,000**
TOTAL[a]	93,400,000	120,000,000	**140,000,000**

*This table is intended to include only products made of calendered film up to 10 mils in thickness. Everything 10 mils or over is classified as sheeting. However, it is impossible to eliminate a certain amount of overlapping between film and sheeting and between various classifications of products given above. The figures are given as approximations to show trends. Accurate statistics are not available. See text for discussion.

[a]This total includes film made from imported resin.

[b]1959 figure is down because great quantities of finished goods in these classifications were imported from Hong Kong and Japan.

Molded and extruded polystyrene products*



*These charts are based on domestic consumption of general-purpose and impact polystyrene. They do not include copolymers and exports.

pected to help the industry reach a volume of around 1½ billion lb. in the mid-1960's are: flooring, which could go to 250 million within a few years; wire and cable coating, which could get up to 175 million or more by 1965; plastisols; unplasticized or low-plasticized resins; and vast amounts of resin coating in various forms to be used (To page 196)



POLYSTYRENE

Styrene-type plastics have assumed second place in total volume among plastics materials—now close to 900 million lb. . . . should reach a billion in 1960. Increases in 1959 included nearly all categories, but refrigeration was largest, with volume of around 100 million pounds. Packaging uses growing at furious rate . . . impact styrene is about one-half of total molding-extrusion volume.

The biggest eye-popper in the plastics industry in 1959 was polystyrene. Any plastic material showing a gain of more than 150 million lb. in one year is sensational. But when that gain comes to a resin with a 400- to 500-million-lb. volume that is supposed to start leveling off, it is terrifically sensational. Not even the producers can put their finger on any one particular reason for this upsurge, except that sales improved in every category.

A man can expect this sort of thing to happen in polyethylene or vinyl chloride, which cover

Styrene-type resin sales, 1955-1959[a]

Use	*1955* lb.	*1956* lb.	*1957* lb.	*1958* lb.	*1959* lb.
Molding and extrusion materials[b]	386,000,000	402,000,000	429,000,000	476,000,000	665,000,000
Protective coatings for paint and paper	94,000,000	93,000,000	85,000,000	104,000,000	130,000,000
Resins for other uses[c]	92,000,000	108,000,000	133,000,000	144,000,000	95,000,000
TOTAL	572,000,000	603,000,000	647,000,000	724,000,000	890,000,000

[a] Source: U. S. Tariff Commission base, except 1959, which is estimated.
[b] Includes plasticizers, fillers, and extenders; modified and copolymer molding or extrusion materials. This 1959 figure indicated above also includes over 90 million lb. of exports, and some 30 to 40 million lb. which is not reported in the Tariff Commission's monthly statements. The Tariff Commission reports exports in "resins for other uses." In previous years the export figure was reported partially in molding materials, and MODERN PLASTICS is merely repeating that formula in order to indicate the total volume of molding material consumed of the combined domestic and export figure.
[c] Includes high-styrene butadiene rubber reinforcing resins; ion exchange resins; polystyrene used in floor coverings, metal treating resins; foam and probably some off-grade molding resins.

MISCELLANEOUS POLYSTYRENE PRODUCTS*

- Lighting fixtures
- Toiletries
- Monofilaments for brushes
- Molded furniture drawers
- Office equipment
- Seasonal decorations (Christmas ornaments)
- Pipe and fittings
- Soil pipe
- Photo equipment
- Dental plates
- Baby equipment
- Window shades (pulls and Venetian blinds)
- Clothes pins
- Recording tape spools
- Sun glasses
- Bar supplies and stirrers
- Toilet seats
- Vacuum cleaners
- Fishing equipment
- Film for packaging and laminating
- Sheet for packaging, lighting, signs, etc.
- Phonograph records

* Breakdown by products of percentage shown in chart on facing page.

a broader base. But it's a regular block-buster in the more confined polystyrene business and makes styrene a candidate for that billion lb. plastics goal in a year or so. If current estimates are correct, the combined total of all styrene will have gone ahead of vinyl chloride in 1959.

There are several factors that help explain this big gain (which should have been foreseen back in 1958 when polystyrene gained more ground than any other plastic except polyethylene while the others held even or dropped back). A price cut in both crystal and colored material at the start of the year contributed to some extent. But producers say that it takes a year before the effect of a price reduction shows up in full volume. For example, the cut price in 1959 probably had little if any effect on use of polystyrene in refrigeration—it would have been big at the old price. Probably the increasing use of impact styrene type resins has been a more important factor in the industry's growth.

There is also some suspicion of shenanigans going on in the collection of statistics, but shenanigans or not, the resin producers seem to be happy—they were almost all operating at near capacity, at least through September.

There were also less complaints about profit margins due to low prices. The suspicion about the accuracy of the figures goes back several years and is difficult to explain. It is reminiscent of Mark Twain's quote from Disraeli: "There are three kinds of lies—lies, damn lies, and statistics."

Basically, the statistics problem in polystyrene derives from great quantities of off-grade or Grade B resin and from export. It seems evident that large quantities of off-grade resins, which are sold largely to reprocessors, were reported in "other resins" in earlier years. There is probably some of it still in the 95-million-lb. figure for "other resins" in 1959. But the bulk of it has now been switched to "molding and extrusion materials." This move apparently started in 1957, became more prevalent in 1958, and is pretty general among all companies in 1959. Thus, the figures for molding material in earlier years were lower than actual volume and the figures for "other uses" were high. It is also likely that the 1958 molding powder figure is low since some companies were reporting off-grade resin in the "other resins" classification at that time.

This off-grade situation also helps to explain why no one could ever give a satisfactory explanation of how the totals in "other resins" could be separated into such things as ion exchange, foam rubber reinforcements, and "fines" and come up with a 100-million-lb. market.

The export market figures are confusing because producers were asked to put them in "all other resins" for the first time in 1959—in other years exports were included in whichever category they belonged—molding, coating, etc. The total export of all types of styrene resins in 1959 was around 110 million lb., of which 80 to 90 are estimated to have been molding or extrusion material. This amount has been deducted from the Tariff Commis-

sion's report of "all other resins" and placed in the "molding" classification in the Modern Plastics tabulation on p. 100 so that this figure will be more comparable with previous charts.

Over the years there has also been a switching back and forth of "coating" and "all other resins" in the industry's reports to the government, so that the coating figure has seemed low in the past years. But that situation has now been corrected according to last report.

Still another trouble is that several of the smaller polystyrene producers report only on an annual basis, resulting in the government's annual report always showing a higher total than the sum of the monthly figures. This amount is estimated at around 35 to 40 million lb. for 1959, and is included in the 665 million lb. total in the table on p. 100.

The price reduction mentioned earlier came in January 1959, when general-purpose crystal was dropped from 24¼¢/lb. to 21½ cents. Price had been on the decline since 1953 when it stood at 32 cents. Ever since that time there has been a history of price jockeying and price chiseling that set the industry on edge. The list price of 24½¢ in 1958 was far from firm, so Monsanto took the bit in its teeth and instead of the ¼¢ to 1¢ cut which had been manipulated in discounts and what-not in recent years made a substantial 2¾¢/lb. cut. Other companies quickly followed, and that price has been fairly firm ever since, with the usual exceptions of a few companies where lower prices are a necessary part of their marketing operation.

A feature of this price reduction was that it carried impact styrene along with it. The price of impact formulas had remained fairly level for a number of years, despite the cuts in general-purpose material. But this time, medium-impact was reduced from 29½¢ to 28¢ and high-impact from 32 to 31 cents. It is interesting to note that a great part of the polystyrene growth in 1959 was due to this last material, which carries a 6½¢ to 9½¢ premium price over general purpose.

There are various formulations in between these prices, such as light-resistant material that sells for 23¢ and super impact at 38½¢; and the copolymers are all selling at a higher price level.

Another variety of impact was put on the market last year that is reminiscent of the blending that is going on in the polyethylene business. Some polystyrene molders do their own blending of general-purpose and high-impact polystyrene resins, but a new angle in 1959 was one resin producer's promotion of a super-high impact with a more-than-usual concentration of rubber which the producer urges molders to blend with general purpose styrene to obtain a low-cost medium impact. The molder, for example, could blend 1 lb. of a 38½¢ concen-

GROWTH OF FILM PACKAGING MARKET

One producer's estimate, millions of pounds

	1957	1958	1959	1960	1961	1962
Cellophane	398	415	427	441	454	467
Polyolefins[a]	145	175	198	276	326	396
Pliofilm	18	19	23	25	27	29
Vinyl	9	10	12	15	17	19
Saran & Cryovac	12	14	15	17	19	20
Mylars	3	4	5	5	7	8
Cellulose Acetate	5	5	5	5	5	5
Total	590	642	685	784	855	944
Extrusion Coating	28	34	44	52	61	70

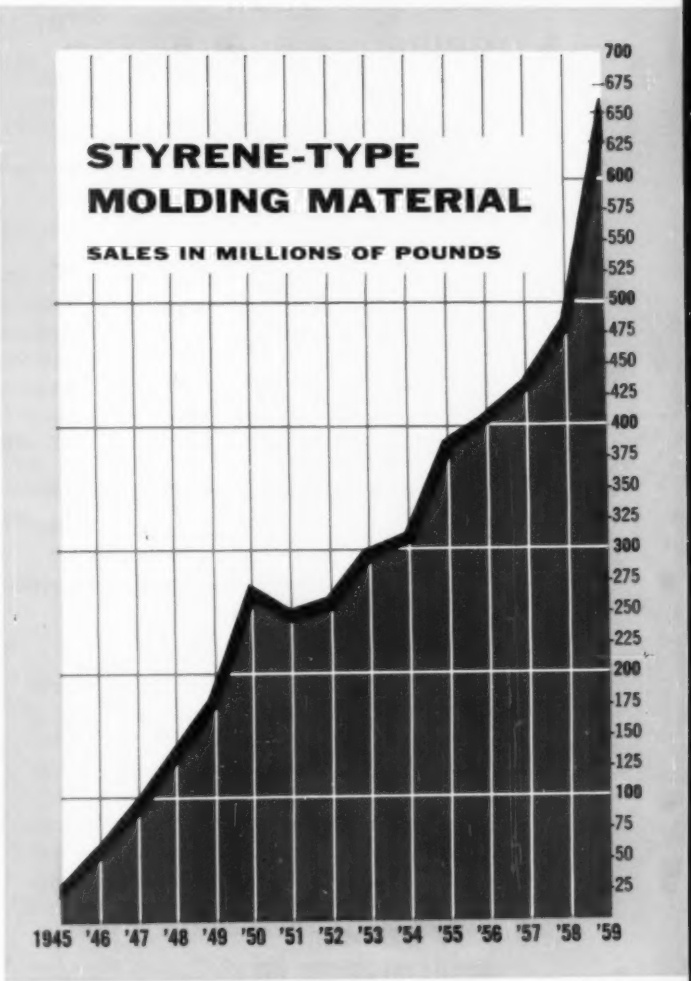
[a] Includes high- and low-density polyethylene and polypropylene. It is estimated that 10 to 15% of the market will be in linear (high density) polyethylene and polypropylene by 1962, although, at present, the degree of penetration is extremely conjectural.

trated super-high with 3 lb. of general purpose at 21½¢ and come up with an impact material for around 34 cents.

However, there was a bigger surprise in pricing last year than the drop in general-purpose and impact. That was the introduction of Dow Chemical Co.'s VIP (voluntary inventory production) plan which has substantially reduced the price of a great portion of all the colored styrene used. It is essentially based on pooling of orders to permit production on a scale that allows a reduction from a former premium of 3½¢ or 4¢ over uncolored polystyrene to 1½¢ or 2¢ a pound. The molders give their producer advance knowledge of how much colored resin they expect to require; the producer can then pool these orders to make one big batch. Other producers have adopted a similar system, and, according to reports, it has worked satisfactorily. Special colors of smaller volume still require a premium price of 3 to 4 cents.

The total figure of 665 million lb. of molding material in the table on p. 100—which includes exports—is an astounding sum. There are those who would make it even higher. Some estimators believe it is near the industry's capacity exclusive of those who produce ABS (styrene-acrylonitrile-butadiene) formulations. A separation of this sum into its various components would look something like this:

General purpose material	260	million	lb.
Impact material	265	"	"
Copolymers	60	"	"
Exports	80	"	"
Total	665	"	"

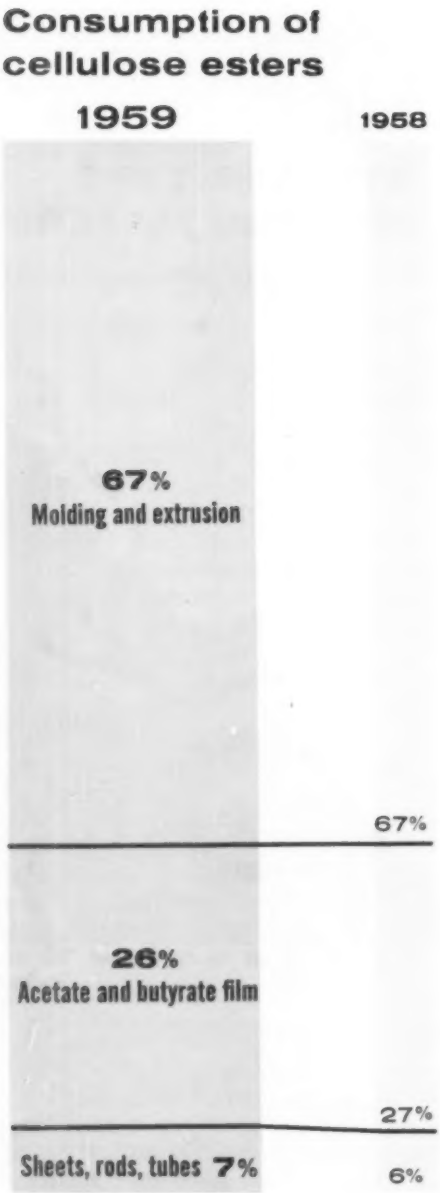


There are no two producers who will agree on the exact figures in this separation but most of them will say: "it is in the ball park." The copolymer and export totals are each considered 10 million lb. high by some analysts. The difference between general-purpose and impact is a matter of dispute, especially with the Tariff Commission's monthly figures showing a big margin in favor of resins other than general purpose. However, as mentioned before, the government's figure includes copolymer and does not include those producers who report on an annual basis only. The latter account for 35 to 40 million lb., primarily general-purpose resin. The best guesses available indicate that the breakdown between general purpose and impact resins is close to half and half, but the ratio is growing in favor of impact each year.

Efforts to obtain an estimate on how much impact resin is extrusion grade are completely frustrating. Raw material producers and extruders are far apart on their estimates but a look at the market would seem to indicate that it must be approaching 100 million pounds.

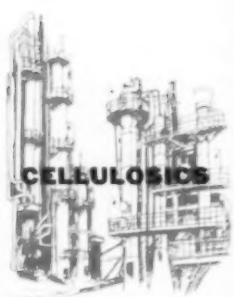
Estimates on copolymers bracket acrylonitrile-styrene in the 20- to 25-million-lb. class; the balance of the 50- or 60-million lb. total is ABS, including filler material.

There are now 12 companies producing polystyrene. Amoco will have sizable quantities in 1960, although their new plant in Illinois is not scheduled to go on stream until 1961. Shell Chemical has not made its position clear, although the company has been sampling for



some time and has taken over the former Cymac laboratory facilities from American Cyanamid in Wallingford, Conn. for further exploration. Dow, Monsanto, Foster Grant, and Seamco have reportedly expanded their facilities without much fanfare.

It is possible that consumption will grow at least another 100 million lb. in 1960, with a good portion of it in refrigeration, packaging, and appliance housings. Sales managers would like to believe that poundage growth will equal the more than 150 million lb. increase in 1959 but are leery about pointing out specific spots where the growth will develop. An interesting area that continues to pile up increases year after year is export, though there are now many plants in foreign countries. (To page 204)



Cellulosics' modest gains were triggered by growth in vacuum forming where acetate and butyrate sheet are among favored materials . . . magnetic and recording tape also on the rise. Acetate molding material has dropped due to decline in one or two major applications . . . butyrate and propionate now constitute well over half of molding and extrusion business in the cellulosics family.

When scanning the cellulosics table below, it can be noted that the total for each of the four years preceding 1959 is almost the same. The entire range extends from 131 to 136 million lb. a year. But the year 1959 shot up to 152 million pounds.

No particular classification was responsible

Cellulose plastics sales, 1955-1959[a, b]

Classification	*1955*	*1956*	*1957*	*1958*	*1959*
	lb.	*lb.*	*lb.*	*lb.*	*lb.*
Cellulose acetate and cellulose acetate continuous butyrate sheets:					
under 3 mils	19,000,000	19,400,000	18,000,000	16,300,000	19,000,000
3 mils and over	15,000,000	16,700,000	18,000,000	17,700,000	20,500,000
All other sheets, rods, tubes	7,000,000	7,000,000	7,200,000	8,600,000	10,500,000
Molding and extrusion materials	90,000,000	92,800,000	93,000,000	90,500,000	102,000,000
TOTAL	131,000,000	135,900,000	136,200,000	133,100,000	152,000,000
Nitrocellulose: sheets, rods, tubes	5,100,000	5,300,000	4,100,000	3,100,000	2,400,000

[a]Source: U. S. Tariff Commission, except 1959, which is estimated.
[b]Includes plasticizers, fillers, and extenders.

PRODUCTS USING PLASTICS IN LARGE QUANTITIES

Products	1946	1953	1958	Est. 1959
Air conditioners (Room units)	28,800	1,044,700	1,600,000	1,210,000
Floor type vacuum cleaners	2,289,400	2,777,700	3,295,000	3,500,000
Television sets	6,476	7,215,800	5,140,000	5,850,000
Refrigerators	2,100,000	3,650,000	3,116,700	3,476,000
Radios	15,955,000	13,369,000	11,200,000	13,350,000
Washing machines	2,020,200	3,460,000	3,668,000	3,800,000
Automobiles	2,148,700	6,116,900	4,257,000	5,520,000
Trucks and buses	940,800	1,206,200	877,300	1,110,000
Dwelling units (Non-farm)	671,000	1,200,000	1,209,400	1,385,000

[a] Factory sales in units

for this growth. All categories increased at comparable rates. Considering the partial loss of several substantial markets, such as dolls, shoe heels, telephone sets, and considering the fact that cellulosics are higher priced than the big volume thermoplastics, this 5-year record is remarkable, and the more-than-usual increase that was recorded for 1959 is certainly an indication that the customers who use it are sold on the material.

There have been no new large-volume end uses—except thermoforming—to take the places of the lost markets mentioned above. The industry has had to depend on increasing volume of its tried and tested products to both make up for the losses to other materials and increase its total volume.

A steadying and welcome factor in the industry was the evening up of monthly sales during the year, compared to former violent ups and downs. For example, the thinnest film ran from 1.4 million lb. to 1.6 million per month, and molding materials fluctuated only from 7.8 to 9 million per month.

There may have been a decline in November and December, since butyrate could have been hurt in the automotive market, but otherwise there were no peaks and valleys. In fact, for the first time in history, there was no decline in July and August.

The largest market for film under 3 mils is recording tape. It's getting bigger every year, despite growing competition. A good quantity is used for metallizing and gold stamping. Other important markets are window boxes and window envelopes.

Acetate packaging film in the "under 3 mils" classification is less than half the total market for this type film. Packagers must pay more for acetate than other films and have to be sold on superior performance. It is still a standard wrap for tomatoes in many localities, but even here there are variations—a Wisconsin packager may use lower cost extruded film. Predictions for this type film are that it will increase 20 or 25% more in 1960. The industry is approaching its capacity for cast film in this thin gage, although one of the producers is giving signs of becoming more active in promotional and sales efforts.

Continuous film of over 3 mils probably owes the major portion of its growth to vacuum forming. Only three companies report to the government in this film classification, but there are several other producers. Their poundage is accounted for in the "molding and extrusion" classification of the table and represents material sold by the supplier.

Continuous film is cast in thicknesses that may go up as high as 20 mils and, of course, includes butyrate as well as acetate. Skin and blister packaging have had a considerable part in the increasing poundage of the material. In this application, cellulosics are still the predom-

COST TABLE: Papers – Films – Foils[a]

MATERIAL[b]	Cost per lb.	Yield, sq. in./lb.	Cost per 1000 sq. in.
Glassine			
Bleached, 25 lb.[c]	$0.248	17,280	$0.014
Lacquer, coated, moisture-proof, heat sealing, 28 lb.[c]	0.455	15,428	0.030
Laminated, amber, 47 lb.[c]	0.30	9,191	0.033
Laminated, bleached, 47 lb.[c]	0.31	9,191	0.033
Waxed paper			
Bread-wrapper grade, 39 lb.	0.23	11,080	0.021
Liner grade, moistureproof, amber, 29 lb.	0.283	14,897	0.019
Cellophane			
Moistureproof, heat sealing (300 MS)	0.62	19,500	0.032
(300 MS 51 or MS-1 type)	0.62	21,000	0.030
Moistureproof, water resistant (300 MSA or MSB)	0.69	19,500	0.035
Polymer-coated (300 K, OX or R)	0.79	19,500	0.041
Cellulose acetate			
Cast (1 mil)	0.93	22,000	0.042
Extruded (1 mil)	0.74	22,000	0.034
Cryovac (60 gauge)	1.17	28,700	0.040
Pliofilm (55-75)	1.10	33,000	0.033
Polypropylene (1 mil)	0.93	30,700	0.030
Polystyrene, oriented (1 mil)	0.60	25,400	0.024
Polyester film			
(1 mil)	2.25	20,000	0.112
(½ mil)	2.75	40,000	0.069
Heat sealing (2 mil)	2.60	13,400	0.194
Polymer-coated (1½-mil base)	2.50	27,500	0.091
Polyethylene			
Low density (1 mil)	0.56	30,000	0.019
(1.5 mil)	0.53	20,000	0.027
Medium density (1 mil)	0.68	30,000	0.023
High density (1 mil)	0.74	29,000	0.026
Polyethylene-cellophane (1 mil poly-300 MS)	1.07	11,800	0.091
Saran (1 mil)	1.08	16,300	0.066
Vinyl			
Cast (1 mil)	0.87	21,600	0.040
Extruded (1 mil)	0.73	21,500	0.034
Foil-acetate (1 mil Al. foil-1 mil acetate)	1.47	6,490	0.230
Foil label stock (0.00035 Al. foil-30 lb. paper)	0.44	9,240	0.048
Aluminum foil (unmounted)			
Thickness, inches			
0.00035	0.825	29,300	0.028
0.001	0.69	10,250	0.007

[a] This comparison of approximate costs is intended only as a guide. The figures given were obtained from 1959 price lists and are based on "volume" orders. Courtesy, 1960 *Modern Packaging* Encyclopedia Issue.

[b] Typical packaging gauges, standard commercial grades, unprinted, are given here. The reader must understand there are other commercial grades, thicknesses and types.

[c] Based on a ream of 500 sheets, 24 by 36 in., or 3000 sq. ft.

inating plastic, despite attempted competition from other materials.

Other uses for over-3-mil continuous film include the printing arts, binders, pass cases, and some laminates. (To page 208)



METHACRYLATE

A good substantial increase was expected in 1959—a good portion of it due to better business in the automotive industry, but signs and glazing continue to show growth from year to year. Industry still striving to produce an extrusion grade that will match cast resin. Implex (impact methacrylate) now available in four formulations—has also taken over large portion of women's shoe heel business.

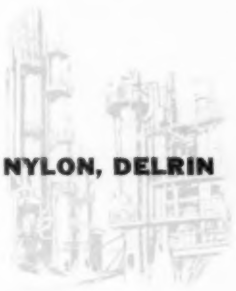
Methacrylate is one of the plastics veterans, even though it has been in commercial production for only about 23 years. Dentists were among the first to use it—in fact dentists became plastics experts in the Army and Navy during World War II because there was a shortage of men that knew much about handling thermoplastics. Dentists are still experts in thermoplastic technology—molders and extruders might learn a few tricks from them. The amount of methacrylate used by the dental industry is not made public—it is a small part of what has grown into a 100-million-lb. (monomer) business. But the technology involved in dentistry probably rates among the highest levels in plastics engineering. From a technical point of view, molding and casting techniques of the business are about the same as they were years ago. The quality of molded parts and cast sheet is, however, much better today. There have been some outstanding developments such as the introduction of Implex, a high impact material; continuing efforts to produce an improved extrusion grade for sheet; increased size of cast sheets, together with a growing number of firms who do casting; and development of a distribution system whereby sheet can be obtained in small quantity when desired.

A dreamer could visualize interesting possibilities for methacrylate if it should ever drop below 40 cents. It has often been called the most beautiful of all plastics, and its weatherability is supreme among the low-cost thermo-

plastics. The price has dropped from 70¢ in 1947 to the current price of 55¢, but it is still one of the higher priced thermoplastics.

Attempts to develop a methacrylate with a harder surface have been generally successful. There are always rumors floating around of "big things" going to happen, but they generally fade away. For years and years there has been talk of a new system for making a lower-cost resin but so far it seems to have eluded all efforts. Time after time there have been developments of a methacrylate with a harder surface; but such material has drawbacks in other properties, is expensive, and in low-volume use. And now Baker Chemical of Phillipsburg, N. J. has come out with laboratory quantities of a higher heat-resistant methacrylate containing alpha methylstyrene (resistant up to 250° F., which is 50° more than conventional methacrylate) at what is thought will be a comparatively low premium price. But markets for such a material must still be developed. Another development is a styrene-methacrylate copolymer priced at 49¢ that is seeking markets now in the methacrylate field. This material is still under test for weathering properties to see if it is suitable for signs and automotive applications.

Methacrylate molding material has been around long enough so that it has been tried out for almost every application where it might be useful. Not many new big-volume uses have been found over the last 10 years. Automotive lenses, dials, and medallions still consume a healthy portion of molding compound production. The Chevrolet alone may have consumed in the neighborhood of 3 million lb. in 1959 because of an overlarge tail light. (To page 182)



NYLON, DELRIN

Nylon plastics are now produced by four companies in the U. S., but only one produces nylon-6/6, the original material. Nylon-6 is produced from caprolactam by a European process. Nylon continues to grow in applications such as gears, bushings, etc., and wherever self lubrication of moving parts is important. Delrin is Du Pont's new acetal resin with superlative properties now in semi-works volume.

Nylon

Sales zoomed upward in 1959 and were 40 to 55% ahead of 1958; but the latter year was considerably under 1957. October of 1957 was the greatest volume month on record until 1959, but sales tapered off after that as a consequence of the general business decline in 1958. Then came the big boom in 1959 and ny-

EXPORTS RELATING TO PLASTICS

(In millions of pounds)

Materials exported	1956	1957	1958	1959[a]
Urea and melamine plastics	17.8	19.6	21.0	10.5
Vinyl and vinyl copolymer resins, uncompounded	33.7	30.2	21.7	11.8
Vinyl and vinyl copolymer resins, compounded	13.7	15.1	21.0	13.0
Cellulose ester molding and extrusion compounds	8.0	8.1	9.0	5.2
Cellulose ester plastics except molding, extrusion, and scrap	10.6	11.6	9.8	5.2
Vulcanized fiber	6.8	6.3	4.1	3.4
Styrene polymer and copolymer resins	57.9	63.1	89.0	53.2
Polyethylene resin, unfinished and semi-finished, except laminating film and sheeting	—	192.0	242.0	148.8
Polyethylene film and sheeting, except laminating	—	—	9.6	3.2
Ion exchange	—	—	1.7	2.9
Laminated shapes	—	—	2.5	1.5
Decorative laminates	—	—	3.0	1.6
Methacrylate	—	—	12.4	5.6

[a] First six months

lon boomed along with it. However, last-half-year sales were moderately reduced due to the steel shortage which cut into auto and appliance production. Automobiles are estimated to use from ½ to 1 lb. of nylon per car.

Estimated sales of all types of nylon plastics, including monofilament, were from 20 to 30 million lb. in 1958. The monofilament volume in 1958 was thought to be in the 5- to 6-million-lb. range. Perhaps 1.5 million lb. were used for rope and maybe 500,000 lb. for fish lines, with the balance for brushes. The remainder of the output was molding and extrusion. There is no way to confirm these figures, since the largest producer does not reveal the company's sales volume. The estimates given here were made by that company's competitors or by companies who may be considering entrance into the business and have studied the market possibilities in some detail.

There were no new entrants in the nylon plastics field in 1959. Du Pont is the sole producer of nylon-6/6. Allied, Spencer Chemical, and Foster Grant produce nylon-6 (caprolactam). The latter two admit to capacity of 1 or 2 million each—Allied has never given any indication of its capacity. Other companies may be interested in producing nylon for fabric, but there has been no announcement of interest in nylon plastics. A fascinating angle is Du Pont's construction of a caprolactam plant in Ohio, which will produce monomer by a new lower-cost process. The company has (To page 217)

Delrin

While not yet announced as in commercial production, there has been enough Delrin around in the last year or so to give an idea of what it is going to be like. Commercial quantity production is expected any day now.

Du Pont, the producer, is reported to have spent more dollars for development and promotion of this material than it did for nylon. Any person in the plastics industry who doesn't know about it by now must have bad hearing and eyesight. This is a thermoplastic resin with remarkable characteristics—hardness, stability, durability, low shrinkage, high heat resistance, moldability, and other favorable properties. But the most exciting factor is that it is potentially a low-cost resin with the properties of a high-cost material.

The current price is 95¢, which makes it about the same cost as nylon when specific gravity is considered. Du Pont says it will go into the 80¢-bracket when reasonable produc-

COST TABLE: Plastics for molded containers

Type of material		Base price[1] per lb. $	Specific gravity, molded	Cost per cu. in., cents	Color range	Molding method[5]
Acrylics	Clear	0.55	1.18	2.36		I
	Colors	0.59	1.18	2.51	Unlimited	
Cellulose acetate	Clear	0.52	1.3	2.44		I
Translucent	Colors	0.48	1.3	2.25	Unlimited	
Opaque	Colors	0.40	1.3	1.88	Good	
Butyrate	Clear	0.62	1.28	2.87		I
	Colors	0.62	1.28	2.87	Good	
Delrin	Natural	0.95	1.43	4.88	Unlimited	I
	Colors	1.04	1.43	5.37	Unlimited	I
Ethyl cellulose	Colors	0.67	1.15	2.74	Good[4]	I
Melamine[2]	Colors	0.47	1.50	2.55	Good[4]	C
Phenolics[2]	Brn. or blk.	0.195	1.36	0.95	Limited	C
Polyethylene	Natural	0.35	0.92	1.16		I
	Colors	0.39	0.92	1.30	Limited	
High density	Natural	0.38	0.95-96	1.31	Limited	I
	Colors	0.44	0.95-96	1.51	Limited	I
Polypropylene	Natural	0.42	0.90	1.37		
	Colors	0.51	0.90	1.63	Good	I
Polystyrene[2]	Clear	0.215	1.05	0.88		I
	Colors	0.255	1.06	1.01	Unlimited	
Modified styrene[3]	Natural	0.31	1.07	1.21		I
	Colors	0.345	1.07	1.33	Good[4]	
Ureas	Colors	0.34	1.50	1.84	Good[4]	C

[1] The prices given here are those prevailing at the time this table was prepared. Current prices should be obtained for purposes of actual comparison.
[2] General-purpose grades.
[3] Available styrene acrylonite, $0.41 clear, $0.44 colors and methacrylate styrenes, $0.49 clear.
[4] In solid colors. [5] I—Injection molded. C—Compression molded.
Courtesy 1960 *Modern Packaging* Encyclopedia issue.

tion volume is attained. But there is no comment from the company on possibilities of a lower price after that. Du Pont will probably take plenty of time before lowering the price by a substantial figure, and Delrin isn't likely to reach the price level of the other big volume thermoplastics for a long time. (To page 209)

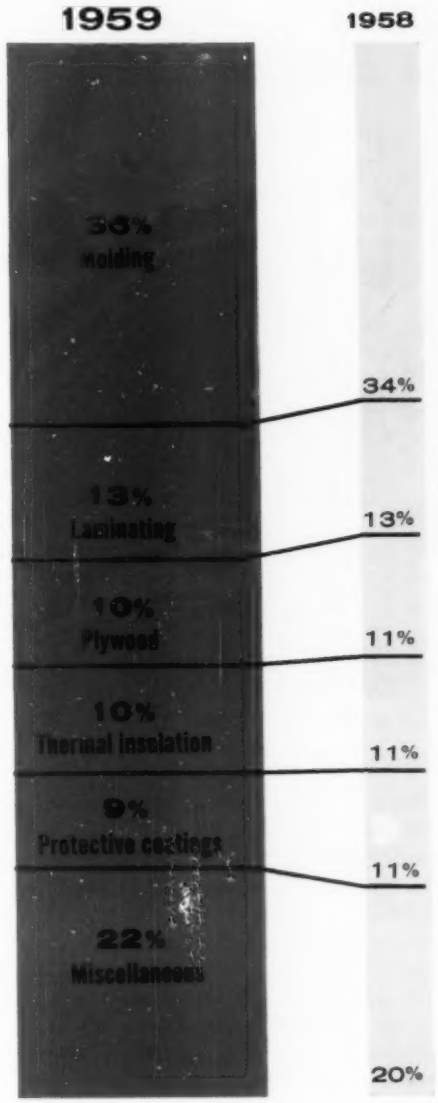


PHENOLICS

Phenolic production broke all records in 1959, with increases in every classification. Molding material was particularly outstanding . . . grew about 50 million lb., after a serious decline in 1958. Small losses in some markets were more than compensated for by gains in electrical and appliance fields. Cores for decorative laminates and panels for printed circuits helped laminates to highest level since war.

Early Wynn of the Chicago White Sox isn't the only "old" man who made a comeback in 1959. Old man phenolic-molding-material did pretty well too—with the greatest or close-to-greatest volume year ever experienced. Phenolics are the oldest synthetic plastics resin with commercial production of molding material, starting in 1911, just nine years before the above Mr. Wynn was born. And again like the above Mr. Wynn, phenolics had a couple of

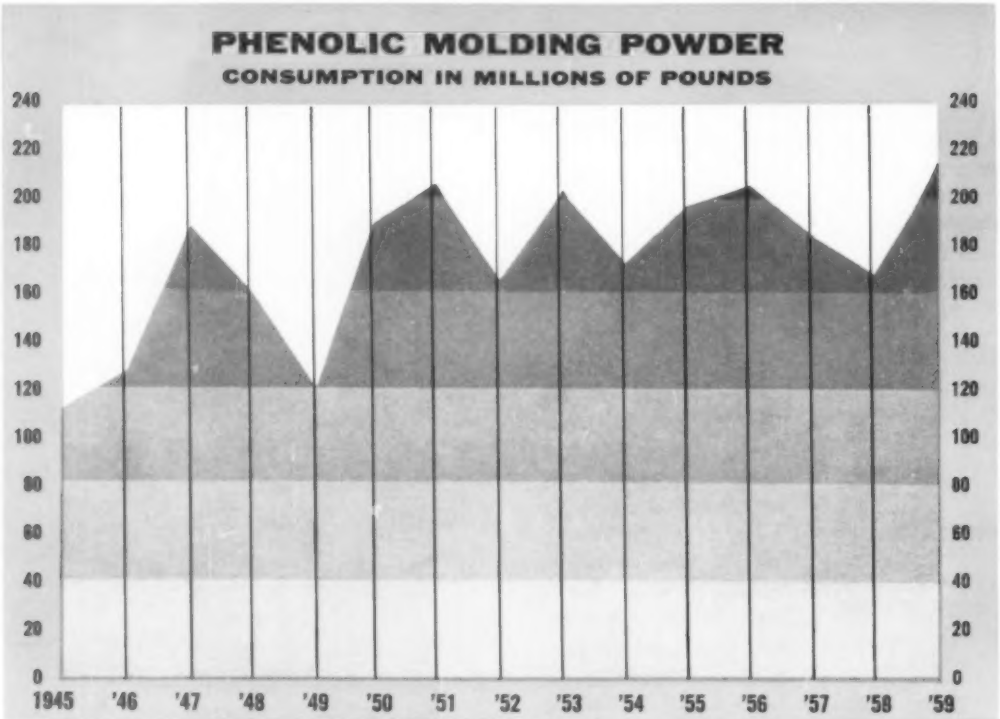
Phenolic production by end uses



Phenolic resin consumption[a, b]

Use	1955 lb.	1956 lb.	1957 lb.	1958 lb.	1959 lb.
Molding materials	200,000,000	204,000,000	184,000,000	168,000,000	218,000,000
Laminating resins	82,000,000	70,000,000	74,000,000	63,000,000	80,000,000
Abrasives	16,000,000	16,500,000	17,000,000	12,000,000	16,000,000
Friction materials, brake linings, etc.	22,000,000	16,000,000	16,000,000	13,000,000	15,000,000
Thermal insulation	52,000,000	55,000,000	53,000,000	45,000,000	56,000,000
Plywood	36,000,000	42,000,000	47,000,000	52,000,000	58,000,000
All other bonding resins[c]	27,000,000	32,000,000	51,000,000	40,000,000	62,000,000
Protective coatings[d]	25,000,000	26,000,000	50,000,000	53,000,000	57,000,000
Resins for all other uses	29,000,000	37,000,000	40,000,000	42,000,000	42,000,000
TOTAL	489,000,000	498,500,000	532,000,000	488,000,000	603,000,000

NOTE: Production figure is used last three years instead of consumption as in other plastics since a large part of industry is captive and production figure is thought to be more truly expressive of actual consumption and difference between production and sales is relatively minor. [a] Source: U. S. Tariff Commission, except 1959, which is estimated. [b] All on solid resin basis, except molding materials, which includes about one-half filler. [c] Many analysts believe this figure is low and that much resin in this classification is erroneously reported in "resins for other uses." [d] Years 1955 and 1956 do not include certain modified resins that were reported in another section of Tariff Commission report.



mediocre years before 1959. Some persons doubted that it would ever again equal the record-breaking year of 1955, but, true to its reputation of unpredictability, phenolic bounced back with a resounding thump. There are now many analysts who believe that a 250-million-lb. year is not many years away, whereas the gloom-boys had the industry leveling off at a relatively steady 200 million lb. maximum not so long ago.

There were at least two unusual circumstances accompanying this upward surge in 1959. One was that there was no price advance except a ½¢/lb. increase in less-than-tank or car-load quantity. In other high-volume years, the price has nearly always advanced. The price had been reduced to 19.5¢ in 1958 for the most widely used general-purpose formulations when business was down and competition from other plastics materials threatened to move in on various markets. Since this competition still exists, it isn't likely that phenolics will climb back to previous levels unless there is some kind of emergency.

The other unusual circumstance was that the 1959 upsurge was not created by development of new products. The increase was "across-the-board" with most emphasis on electrical applications. In other years a big increase was generally created by development of a new use, such as television cabinets, or through unusual circumstances, such as the Korean war.

However, changes and improvements that have taken place over the years often go unnoticed. The old vet phenolic just goes on about its business without particular fanfare, and its accomplishments are generally buried as a component part of equipment where its use is vital but barely mentioned.

Versatility is another of the factors that helps explain why phenolic molding powder continues to hold its customers.

A look at the properties chart of various formulations by one supplier gives a clue to this versatility. It gives seven different formulations of general-purpose phenolic which offer low-cost material with balanced properties for such a variety of applications as cases, cabinets, housings, tube bases, sockets, switches, other electrical components, control knobs, and utensil handles. This low-cost material can be varied to meet a specific need for anti-corrosion, improved machinability, insulation resistance, and resistance to perspiration acid. And then there

is another similar formulation for non-bleeding used in caps and closures for products containing alcohol.

The next series of phenolics in the properties chart is offered for improved impact for such things as automotive transmission parts, bushings, caster wheels, tool parts, pulleys, instrument casings, and machine housings. Impact for these materials varies from 0.3 to 17 ft.-lb./in. Izod and enables the designer to avoid expensive over-engineering.

Then comes a series of electrical phenolics providing varying properties needed for such different applications as automotive ignition and heavy-duty circuit breaker parts. Another group of formulations are particularly applicable for heat resistance. Most phenolics perform well at temperatures up to 300° F., but several of the standard varieties go as high as 500° F. It is obvious that such materials at comparatively low cost are ideal for electrical iron and utensil handles. And of course there are the specialty phenolics. A good example is for use in pieces that have contact with water, detergents and similar agents, such as washing machine agitators where resistance to soap and water are built-in.

There are literally hundreds of phenolic formulations and the business of building them has been long and laborious. Indeed, phenolic producers may well smirk at the well publicized comment of thermoplastic producers who boast of their 20 to 40 tailor-made formulations for specific uses and state that the customer should be grateful for such good service. However, the phenolic producers have worried for years over this trend toward variation and every now and then will remove a small volume formulation from the market. Of late they have made a determined effort to sell the molder on the idea of concentrating on as few formulations as possible and will show him how a standard material will frequently perform adequately on a job that has always been in a more expensive specialty compound.

Another reason why phenolics continue to hold their place in the sun is that although older formulations sometimes vanish, there is no let-up in the effort to improve standard resins and even new ones are occasionally introduced. In this class are the sisal-filled resins in nodular form for greater impact strength and phenolic bonded glass rovings that can be molded without shrinkage around inserts. They were not new in 1959 but are in their infancy and require a period of time for customers to become acquainted with their possibilities. For further information on new and specialty resins, see the article "Specialty Phenolics" starting on p. 81 of the December 1959 issue of MODERN PLASTICS.

There have, of course, been some disappointments in development of new formulations that never gained much volume but that is true in any plastic and almost any manufacturing operation. Some persons feel that a lack of brightly colored phenolics has been a handicap in the growth pattern but not everyont will agree with this thesis.

Companies have studied the situation for years and seem to have reached a conclusion that production of a colored phenolic is impractical from a cost standpoint and would face difficult competition from other plastics. Attempts to encourage customers to color their moldings with various coatings hasn't caught on. Extra cost may be one reason. Several years ago an epoxy colored coating that seemed ideal was introduced, but there has been no flashing display of brilliantly colored phenolic parts on the market as a result of its use. Customers simply haven't exhibited any "rah-rah" enthusiasm over brightly colored phenolics. (To page 219)



MELAMINE and UREA

Steady growth in melamine molding material developed largely on popularity of dinnerware . . . melamine decorative laminates also growing. Melamine molding powder total now higher than urea. Chief urea end use today is closures, where color and chemical resistance are important. Wiring devices are second. Buttons, once a leader, have suffered by competition from another plastics material.

The over-all urea and melamine consumption volume in 1959 was close to 400 million lb., or around 18% more than in 1958. There was growth in every classification except possibly textile treatment; and even there the revised government figures that are printed later in 1960 may show an increase. Urea is meeting stiff competition in this field from other resins and techniques. A steady volume of around 40 million lb. has been consumed for this application each year for the past five, and a serious

decline is not anticipated. It was hoped that this figure would eventually become much greater, but the figures in the table below indicate that perhaps it has reached the saturation point. The figure of 42 million is larger than indicated by the Tariff Commission's monthly reports, but there are several companies who report on their activities only on an annual basis. Their production is not known until the revised figures are published.

It is probable that the actual total of urea and melamine resin consumption in the United States is more than 400 million lb., since the industry contains scores of small companies who never report to the government. Most of them make glue for wood working and bonding. In addition, there are also several molders who make sizable quantities of molding material that is never reported. However, this makes little difference in the trends that are indicated in the table below.

A change in the reporting system to the government has resulted in including exports of all types of urea and melamine in the "resins for all other uses" figure of 128 million. The export figure will be between 20 and 24 million. Thus the molding powder figure alone will be around 104 million pounds.

Compared to urea, melamine has gone considerably ahead. Urea has not gained much ground for 10 years, while melamine tableware has helped increase production of that resin at a rapid rate. Urea has been in the 30- to 40-million-lb. bracket all through the 1950's, and melamine has grown to an estimated 55- or 60-million-lb. output.

The growth of melamine tableware continued in 1959, and will probably go on at a fair rate for years to come. Tableware has now been on the market for 11 years and more customers, especially among younger people, are buying it. One of its strongest points, break resistance, may hinder sales since melamine requires less replacement than chinaware. Nevertheless, it does get old and styles change. It is likely that if a saturation point in new customers appears, there will be a pick-up to counteract that loss from old customers who are out to buy replacements. A 90-million-lb. market by 1965 is not impossible. There was a decline in sales of resin for dinnerware in October of 1959 after the best September ever experienced, but producers claim this is normal. The two big events for dinnerware sales are the June brides and Christmas presents. The June presents are made by the molder in March and April—the Christmas presents in September and October. But molders start cutting their orders in October in order to end the year with as small an inventory as possible.

The melamine tableware industry management is concerned about the (To page 225)

UREA AND MELAMINE RESIN SALES[a]

Uses	1956 lb.	1957 lb.	1958 lb.	1959 lb.
Textile treating and textile coating resins	40,000,000	38,000,000	42,000,000	42,000,000
Paper treating and paper-coating	25,500,000	23,000,000	23,000,000	26,000,000
Bonding and adhesive resins for:				
Laminating[b]		23,900,000	27,000,000	29,000,000
Plywood	102,500,000	94,500,000	105,000,000	111,000,000
All other bonding and adhesive uses[c]	24,000,000	9,900,000	12,000,000	19,000,000
Protective coating resins straight and modified	29,000,000	26,800,000	25,000,000	29,000,000
Resins for all other uses, including molding[d]	90,000,000	105,300,000	92,000,000	128,000,000
TOTAL	311,000,000	321,400,000	326,000,000	384,000,000

[a] Source: U. S. Tariff Commission, except last 4 months of 1959, which is estimated. [b] Laminating resins were included in "all other uses" prior to 1957. [c] This figure includes resin used for chipboard and commercial adhesives—prior to 1957 it included laminating resins. [d] Includes filler. The total for 1959 includes 55 to 60 million lb. of melamine and 40 to 45 million lb. of urea molding materials. Exports of all types are now included in this figure but in other years were divided among various items.

1959— YEAR OF APPLICATION BREAKTHROUGHS

To the wise observer of plastic applications, the volume growth in plastics products of all types in 1959 was probably nowhere near as important, nor as far-reaching in its implications, as the introduction during the year of a few key products *based on completely new concepts of plastics usage.*

It is, of course, always satisfying to see plastics consolidate their gains. But there's a different type of excitement when plastics encroach on markets traditionally reserved for metals, glass, wood, or other conventional materials.

- Injection molded PE luggage that takes the play away from canvas . . .
- The first appearance of plastics (a phenolic clutch cone) in automatic transmission design . . .
- Reinforced plastics bypassing aluminum in the construction of outboard motor covers . . .
- Blow molded bottles undercutting metal cans in cost . . .
- The first plastics usage (a molded acetal valve) in a traditionally all-brass faucet line . . .

These were among the applications in 1959 that had that special brand of excitement. And they are the reason why 1959 stands out as a year of special significance for the plastics industry, the year in which so many important breakthroughs were made into so many new market areas.

This emphasis on new applications is not surprising. For the past 2 to 3 years, the industry had been concentrating on developing new materials, improving old ones, and refining processing technology; and in 1959 the time was ripe for these developments to find expressions in broadened application bases.

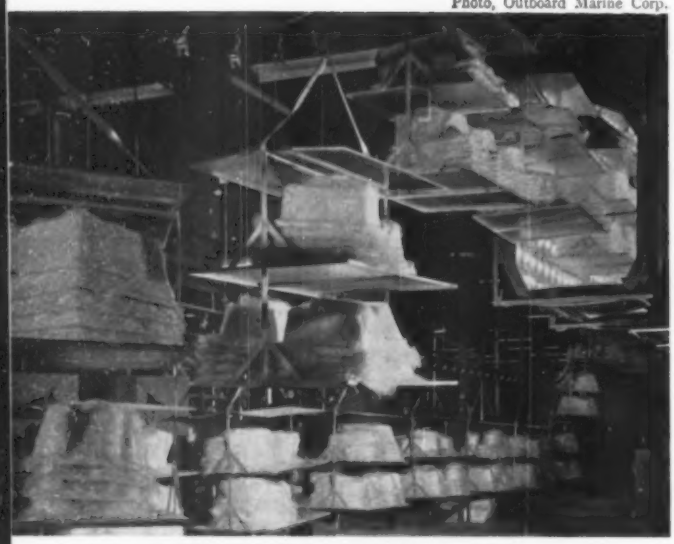
On the pages which follow are some of the year's highlights which can be looked on as breakthroughs into new fields.

The products shown, of course, are by no means the sum of plastics application activity as reported month-by-month in the pages of MODERN PLASTICS. Rather, they have been selected because of their special significance to the plastics industry. It should be noted, too, that many of the applications mentioned and many of the materials that crop up time and again in these applications, e. g., high-density polyethylene, polypropylene, foamed plastics, reinforced plastics, etc., are still relatively "small potatoes" in the over-all picture of plastics usage. Their importance derives not from volume but from their position as harbingers of "things to come."

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Automotive progress p. 114
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REINFORCED PLASTICS HOUSINGS

Photo, Outboard Marine Corp.



CONVEYORIZED HANDLING of preforms is one of features of highly automated production set-up for molding RP motor housings. Housings are 15% less than aluminum counterparts.

After pursuing the industrial and consumer housings market for so many years, reinforced plastics finally began to make some really significant inroads during 1959. The key: automation. The breakthrough: a switch by Outboard Marine Corp. from aluminum to polyester-glass for a new line of motor covers (Feb., p. 87).[1] To provide the economics for the switch (there is a savings of about 15% on a plastic cover for a 35-hp. motor), the firm came up with a high degree of production automation.

The result: not only a new market for reinforced plastics (over ½ million outboard motors are sold annually), but a new concept of mass production that can affect reinforced plastics' progress in many allied fields.

Other RP applications added impetus to the trend: a spray pump unit made from matched-metal molds that cost about 60% less than the dies required for casting aluminum (April, p. 97); a portable paging unit that showed a 20% savings in material and a 25% savings in assembly cost over sheet metal (Sept., p. 93); a switch housing that was put into production with a savings of 4 months in development work and a reduction of $15,000 in model and die costs as compared to a cast iron housing (Aug., p. 72); and a shroud for a lawn mower that showed a 12% part cost reduction over its metal counterpart (Oct., p. 94).

AUTOMOTIVE PROGRESS

Plastics innovations in automobile design in 1959 were far more subtle and certainly less obvious than the much-publicized applications of previous years. But their importance as "ice-breakers" cannot be overlooked.

Take for example the introduction of a clutch cone molded of glass-reinforced phenolic—*the first entry of plastics into the field of automatic car transmissions* (Feb., p. 106). On the basis of reduced production costs, the material's high tensile strength, its resistance to transmission oil and temperatures, and its increased holding power, three leading 1959 automobiles are already using the application—and more to come. Its success can have important ramifications on similar part design.

Ducting for automotive use holds a similar position. A molded high-density polyethylene defroster duct which has already proved itself in the Chrysler line (and has also managed to cut 60¢ off the cost of the elastomeric composition used previously) has encouraged the engineering minds of other manufacturers to look in the same direction (Feb., p. 106). Some observers feel that the high-density PE ducts may be only the first of a long list of possible applications. Stimulated by advances in the

[1] All references are to MODERN PLASTICS.

blow molding technique and the production economics it implies, high-density PE windshield washer tanks, carburetor parts, brake fluid reservoirs, and sun visors are already in production (Nov., p. 83). Estimates are for 3 lb. of high-density PE parts (made by blow molding) per car by 1961; injection molded pieces, e. g., side seat shields, now featured by some car makers and under evaluation by others, could easily double the figure within the next two years. One manufacturer who switched to polyethylene side shields reported that the move saved the company enough steel to produce approximately 5000 new cars of the "compact" variety for its 1960 line.

A subtle change also took place during 1959 in the design of instrument clusters, dials, and similar panels involving decorative elements or transparent faces. For years, it has been the custom to create such parts by combining sheet metal flats, metal bezels, and rubber gaskets with transparent acrylic faces and back-decorated acrylic escutcheons. By the end of 1959, the concept had changed completely. Now, it has become common practice to mold the panel in one piece of acrylic (complete with mounting lugs and holes) and back-decorate to create the escutcheon, dial numbers, etc., and even to simulate the metal bezel. The area which serves as the transparent face is left clear. Result: reported savings of up to 30% (April, p. 91).

Mention should be made too of the appearance in 1959 of acetal and polycarbonate resins as candidates for the automotive market (Aug., p. 67). Carburetor parts, gears, cams, and bearings—in short, *the whole new area of mechanical parts* which require the new materials' impact strengths and dimensional stability—hold promise of becoming one of the plastic industry's most important markets.

Along the same lines, look for more and more plastics to appear *under the hood* in applications such as the molded nylon in-line gasoline filter housing now being installed on 8-cylinder models of the 1960 Plymouth, Dodge, DeSoto, Chrysler, and Imperial. As used between the engine's fuel pump and carburetor to prevent dirt and other foreign material from clogging the carburetor, the nylon-6 housing had to undergo a rugged series of field and laboratory tests before its acceptance. To qualify for production use, the housing was subjected to tough tests—extreme temperatures (250° F. and −40° F. for 24-hr. periods), vibration (1000 hr.) and lubricant resistance testing—and passed all with flying colors.

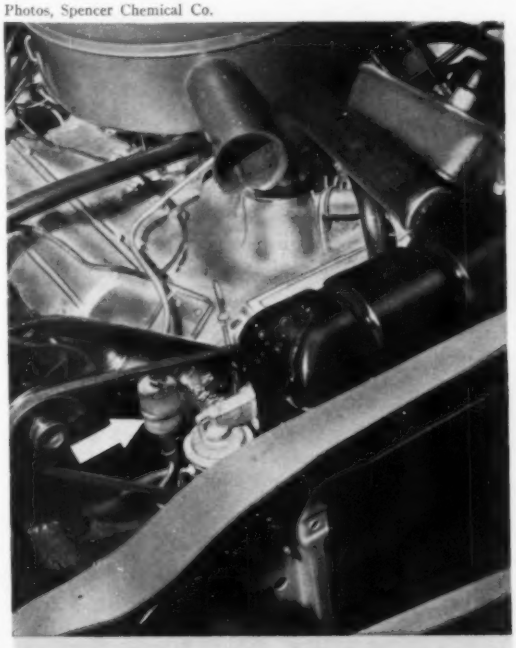
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Photo, Baker Bros. and Durez Plastics



AUTOMATIC TRANSMISSION reverse clutch cone is molded of glass-filled specialty phenolic compound. Material eliminates machining of internal slots, which had to be done with metal.

Photos, Spencer Chemical Co.



IN-LINE GASOLINE FILTER consists of two nylon-6 parts spin welded together. This unit is currently found on the 1960 models of Plymouth, Dodge, DeSoto, Chrysler, and Imperial (see arrow). Close-up of new filter is below.





Photo, Koppers Co. Inc.

SIX-ROOM RANCH HOUSE was erected in 35 man-hours, using wood-faced styrene-foam core sandwiches for walls.

BUILDING

If, as experts claim (see p. 123), the future for plastics in building lies in structural applications which call for astronomical volumes of material, then 1959 must be counted as a standout year in supplying overwhelming evidence to a reluctant building industry of the important contributions plastics can make.

One such development, that of pre-fabricated structural panels based on plastics, is already expected to show up in 1960 housing construction, where it will tie in nicely with the trend to pre-fabrication. In some instances, the face of the sandwich panel could be a plastic skin (e. g., in 1959, a giant radome designed to withstand winds of 150 m.p.h. and extremely low temperatures was built of panels faced with epoxy-glass, Sept., p. 99). But in nearly all cases, we can expect the core to be a foamed rigid plastic that provides insulation, structural strength, and sound deadening and vibra-

RADOME CONSTRUCTED of epoxy-glass laminate sections withstands 150-m.p.h. winds and extremely low temperatures.

Photo, Shell Chemical Corp.



tion dampening characteristics (April, p. 109). One materials supplier who shook up the building world in 1959 by erecting a pre-fab six-room ranch in only 35 man-hours (using wood-faced sandwiches with an expandable styrene core) announced it would be turning out enough panels in 1960 to put up some 1500 homes (March, p. 100). Perhaps not a breakthrough, considering the million or so houses going up each year, but certainly a beginning!

There was also evidence of sweeping new concepts unfettered by demands for conventional materials to meet conventional requirements. One of the most spectacular and widely publicized plastics buildings was the American pavilion in Moscow (Dec., p. 86), pictured below.

"Fresh and original" was also the label for another of 1959's innovations—a new type of decorative sandwich panel with fibrous glass-reinforced polyester skins and a variety of decorative core materials, e. g., treated cardboard, wood, honeycomb, etc. Although the panel is not intended as a load bearing member, it can be used as a curtain wall, room divider, dropped ceiling, "stained-glass" window, and similar applications where illumination, color, interesting textures, and interesting patterns are called for (Sept., p. 88).

On a more practical, work-a-day level, polyester and epoxy resins suddenly blossomed forth as basic building materials. The breakthrough began with the introduction of polyester-faced concrete blocks (the facing, from ⅛ to 3/32 in. thick, consisted of polyester resins mixed with a decorative aggregate such as marble chips, oyster shells, and the like) for interior and exterior use in hospitals, swimming pools, schools, store-fronts, and other structures (May, p. 102). By the middle of the year, builders were starting to apply their own facings by grinding up brick, reconstituting it into a slurry containing epoxy or resorcinol adhesive, and spraying it onto a surface (March, p. 100). And from Europe came news of a new type of flooring consisting of polyester resin cast onto the rough surface and then decorated with suitably shaped pieces of marble laid in place. The next step was obvious. By year's end, one materials supplier had made the logical move and was offering to builders a polyester resin that could be sprayed to set up a hard, chemically-resistant protective finish for concrete blocks (Aug., p. 76). At the same time, a manufacturer of spray guns started to ready for market a unit that could simultaneously spray polyester or epoxy resins and an aggregate material onto a surface. Next year should show the results!

Spectacular advances from the novelty stage to the functional stage were also noted in 1959 for air-supported buildings fabricated of plastics film. The success of a giant airhouse as an army shelter (July, p. 136), a polyester film bubble for a heated swimming pool (Nov., p. 115), and an air-supported structure for greenhouses (Nov., p. 115) lent added weight to the trend.

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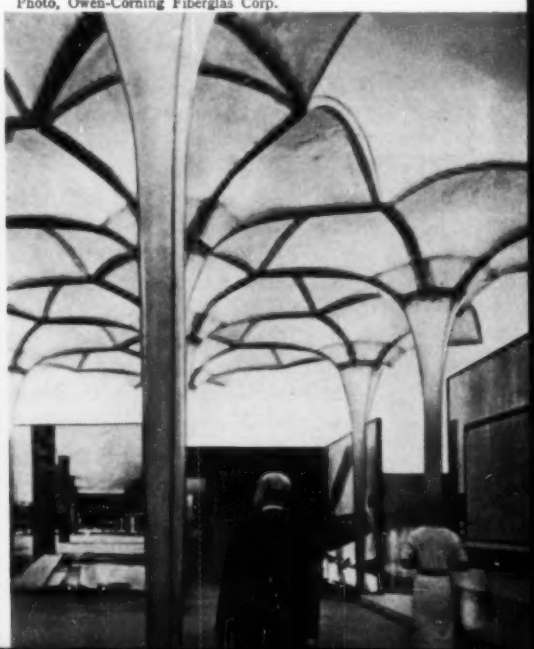
OFFICE BUILDING is decorated with factory produced polyester-faced concrete blocks. This method is much less expensive than glazed tile, granite, and marble, often used to same effect.

Photo, American Cyanamid Co.



REINFORCED PLASTICS umbrellas molded in U.S. and erected in U.S.S.R. housed the U.S. exhibit in Moscow.

Photo, Owen-Corning Fiberglas Corp.



PACKAGING



Photo, Premier Plastics

REPRESENTATIVE of the inroads polyethylene has made in the big-container field are these tanks (produced in depths up to 36 in. by a combination thermoforming and welding technique), which have brought important economies.



Photo, Phillips Chemical Co.

DETERGENT BOTTLES are among major market breakthroughs for blow molded high-density PE. They are now competitive with steel cans, may be lower shortly.

From the welter of plastics applications that kept the packaging industry hopping during 1959, three highly significant trend-setting developments stand out:

1) The reverberations set up by the breakthrough of the blown high-density PE bottle in the field of liquid detergents are still being felt throughout the industry (Aug., p. 73). In terms of the immediate market which it opened up (400 million containers in 1960), the application deserves special mention; in terms of the potential over-all market into which it has projected the PE bottle, it is even more important. The market: containers for household and industrial chemicals of all types; the volumes involved: an annual 80 million containers for liquid floor waxes, 100 million for automotive specialties, 400 million for liquid bleach, 60 million for liquid starch, 70 million for liquid ammonia (Dec., p. 96). If the blow molded PE bottle can pick up just a small share of this market within the next year or so—and from all indications it seems to be headed in that direction—it will be riding high.

2) By the end of 1959, one manufacturer was predicting that within the next 5 years, the percentage growth of plastics in molded *industrial* packaging would be much greater than that in *consumer* packaging—and developments seem to bear him out: A 1-gal. stock high-density PE container introduced earlier in 1959 had topped the 1-million unit sales point by the middle of the year. The "bottle-in-a-box" application, in which a blow molded thin-wall container is inserted into a cardboard carton for industrial shipping, had so taken hold during the year that producers were already tooling up to produce the containers in capacities up to 15 gal. (Dec., p. 96). Huge polyethylene tanks and carboys, available in capacities up to 500 gal., came flooding into the market during 1950 (June, p. 85)—and with good reason. In one reported set of figures, 55-gal. drums were estimated to cost one-third as much as standard glass carboys and to weigh 80% less. Even in cases where they were protected by a steel drum overpack, they are lighter in weight and about 67% less costly than stainless steel drums.

In this same area, mention should also be made of foamed plastics for industrial containers. These have really taken hold in '59; and we can look for big things to happen in 1960—whether the application is in the form of

molded or die cut styrene or urethane containers, styrene foam platform inserts, foam-to-paper laminates, or sheet foam backed up with a pressure-sensitive adhesive.

3) Film, especially PE film, made several notable breakthroughs in the packaging industry. For one thing, machinery manufacturers seemed on the verge of licking some of the production problems previously encountered is using PE film for overwrap. At the Packaging Machinery Show in New York, one manufacturer had on display a unit with a special sealing device capable of overwrapping 150 cigarette boxes a minute with high-density PE film—the exact same speed at which the unit now handles cellophane. Material's developments also highlighted the year's activities in film which saw the introduction of new vinyl fluoride film for packaging greasy or corrosive materials (July, p. 121), and the advent of tailor made film-grade PE formulations to meet specific requirements.

The number of new products that turned up in PE bags in 1959 also attested to the film's growing popularity. They ranged from phonograph records to tortillas and tamales (Aug., p. 204). The latter, incidentally, packed in PE bags that cost $8/1000, were kept fresh for four days, the wax paper bags used previously could only keep the food fresh overnight—and the cost of the paper bags was $10/1000. Not only can PE bags perform better; they cost less.

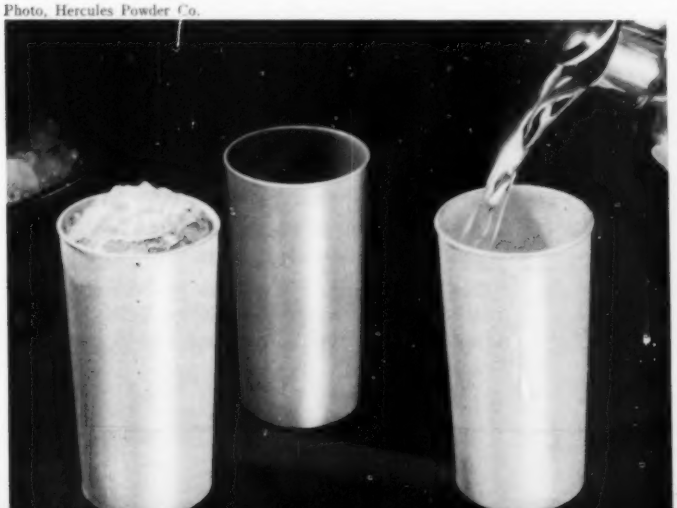
FOR THE HOME

Observers at the 1959 Housewares Show who summed up plastics activities with a curt "more of the same" would do well to take a second and more meditative look at what has been happening to this lush $700 million market. Over-all, some 220 million lb. of resin went into housewares in 1959, with conventional polyethylene and styrene leading the parade and with wastebaskets, buckets, washbasins, canister sets, tumblers, and bowls accounting for the bulk of applications (Sept., p. 212). But what some people failed to notice was the degree to which high-density polyethylene, high-impact styrene, and polypropylene were beginning to creep into the market—and it is here that the 1959 housewares breakthrough begins to take on significance. Instead of replacing the older materials, the newer, tougher, and more heat-resistant plastics have added a new dimension to the housewares picture.

Mixing bowls, for example, are certainly not a new market for plastics, but until the advent of the high-density PE models in 1959, producers had been reluctant to go after those segments of the market in which the rigors of contact with automatic mixers or dishwashers

POLYPROPYLENE TUMBLERS remain unaffected by ice or boiling water, have replaced lower-cost styrene cups.

Photo, Hercules Powder Co.

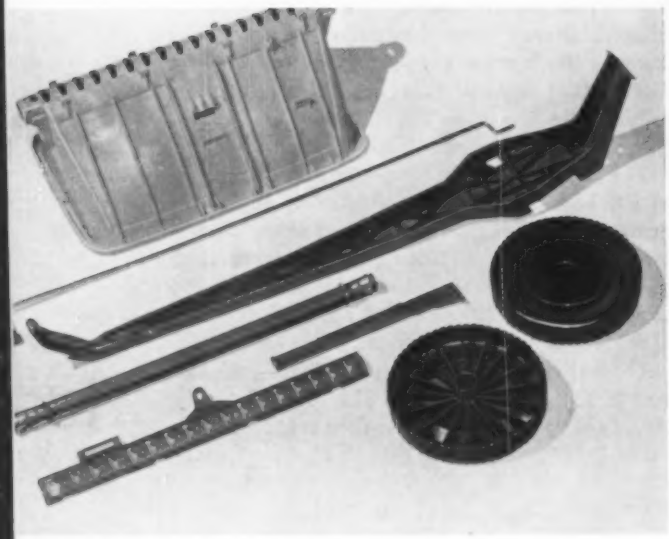


VEGETABLE BINS, molded of 100% high-density PE, can be stacked to any height.

Photo, Rubbermaid Inc.



FERTILIZER SPREADER is manufactured of high-density PE parts, costs and weighs less than metal varieties—and will not rust.





Photos, W. R. Grace & Co.

were involved (Nov., p. 102). Along the same lines, a general upgrading in 1959 housewares design was led by such products as high-density PE colanders that can withstand boiling and cold water, polypropylene crispers that remain undamaged under mallet blows, polypropylene pouring lips for coffee makers that are stronger than glass and cheaper than stainless steel, high-density PE step-on trash cans, and PP tumblers unaffected by either ice or boiling water (July, p. 96; Nov., p. 102; Dec., p. 85).

Blow molding is also expected to have an important effect. With blow molding, it is possible to produce hollow-ware such as pitchers complete with handle and an ice deflector on the rim in one piece—injection molding required the use of inflatable cores or making the part in two pieces and then cementing. (Nov., p. 83).

Outside of the kitchen area, there are three other 1959 home applications that deserve mention as significant trends. Two of these involve garden tools—one, a high-density PE fertilizer spreader that doesn't corrode and sells for $5 less than a comparable metal one (June, p. 95) and the other, a high-density PE engine shroud, discharge chute, and deflector for a lawn mower (June, p. 94). Manufacturers were talking about possibly adopting the concept of blow molded high-density PE wheels for lawn mowers (Nov., p. 83).

Another application of significance was a low-cost polyethylene drape (a 36 by 90 in. panel, 15-gage, sells for 49¢) designed to be replaced after reasonable use (Nov., p. 108). As the second breakthrough into the area of low-cost fabric disposables (a PE disposable tablecloth was introduced in 1957), the drapes mark the fact that the "disposable" concept may be moving slow—but it is moving! Along with low cost, the drapes have a quality appearance that should make them especially appealing to economy-minded motels, cafeterias, etc.

FURNITURE

In an industry as rigidly tradition-bound as furniture making, breakthroughs are rare. Yet, in 1959, there were three!

1) Components for school furniture molded of high-density PE may presage an important new volume market for the material in the general seating field (May, p. 90). As used by a major supplier of public seating, the PE parts are claimed to have a minimum life of 30 years —with virtually no costly maintenance required along the way. Another producer has adopted this development for use on kitchen

stools . . . and further applications along the same lines are expected.

2) Frames for upholstered furniture that are 5 times as strong as those made from wood and that result in finished pieces whose weight is only about one-third that of wood-frame-based types are now being molded of expandable styrene—a revolutionary technique that can bring chairs and sofas previously offered only in expensive lines into the medium price range (April, p. 98).

3) In 1959, over 200 furniture manufacturers were using plastic foam cushioning . . . one major manufacturer who did not even make plastic foam cushions at the beginning of the year now reports that they account for about 40% of his production. A contoured molded vinyl foam cushion, measuring 24 by 24 by 5½ in. was put on the market at $5, as compared with $6.50 for a latex cushion with the same dimensions (May, p. 98). Another manufacturer reported considerable savings by using a contoured polyether cushion joined to a plywood base in a single operation to replace a complex, costly construction made up of the plywood bottom, coil springs, rubberized hair, Tuflex, and a slab of foam (March, p. 91).



Photo, Phillips Chemical Co.

SEATS AND BACKS (shown in front and rear views) molded of high density polyethylene have invaded school furniture field, are moving into other seating applications.

. . . AND SOME INDIVIDUAL HIGHLIGHTS

• Although the sprayup technique for turning out reinforced plastics parts was first introduced in 1958, a number of commercial applications were already out in 1959—nearly all of which pointed up the cost savings which proponents of the sprayup technique had claimed were possible. As just one example, a boat manufacturer reported that a 7 ft. dinghy made by sprayup sold for $179, whereas a comparable model made by hand layup would have cost $218. Other application possibilities for sprayup: industrial structures, machinery safety guards, swimming pools, tanks repair and maintenance, freight car repair, chemical plant piping (May, p. 85).

• An all-vinyl children's shoe came on the market in 1959 to the interest of many manufacturers (June, p. 96). The shoes, retailing at only $2 to $4 a pair (conventional footwear costs $8), are claimed to outwear leather

Photo, Union Carbide Plastics Co.





LOW-COST CHILDREN'S SHOE is fabricated of molded and sheet vinyl, reduces manufacturing operations from about 100 to eight.

Photo, Union Carbide Plastics Co.



Photo, Phillips Chemical Co.

INJECTION MOLDED high-density luggage became a reality with introduction of flightbag by major air line. Bottom photo shows integral hinge construction, making halves interchangeable.



types ten to one. Will it affect the shoe market? If current estimates of sales of 5 million pair (about 10% of the total children's shoe market) are accurate, the answer is yes!

• An injection molded chlorinated polyether wobble plate selected to replace a brass disk and a carbon half-ball in a water metering system aroused two-fold interest: 1) as a breakthrough into a metal-dominated market by a superior material (the plastic plate proved out in a 2-year evaluation test; previous metal parts failed in less than 6 months); and 2) as an indication to industrial end-users of economies inherent in precision injection molding of tough new plastics vs. die cast or fabricated metal parts (Aug., p. 67).

• The successful use of three acetal parts in an egg beater marketed in 1959 helped highlight the fast-moving entry of some of the new, impact resistant plastics into the heretofore unexploited area of mechanical parts. The three precision molded components: a bearing, a bushing, and a retainer. The metals replaced: stamped brass, screw machined brass, and cold rolled steel. The result: no sign of wear after the beater was run to a total of 1 million cycles, smoother and quieter operation, and competitive production costs (Nov., p. 99).

• Pan Am airline adopted a new flight bag injection molded of high-density polyethylene (Oct., p. 92). The new unit looks like and is, in fact, a quality piece of luggage—light in weight, tough, reusable, and properly shaped for space savings in shipping and storage. Excitement already generated by the application gives rise to the distinct possibility that a wide range of low-cost luggage molded of high-density PE or perhaps even of polypropylene may soon be in the offing.—End

The next 5 years in plastics

The startling growth in plastics production to a record figure of over 5½ billion lb. has quite naturally sent the thoughts of men in the plastics industries ahead to the future—with all the attendant questions. Will percentage growth in the next five years be the same as the past five? Will some of the newer materials e.g., foamed plastics, move into the large-volume categories? What is plastics' competitive position in the building field? Will plastics film usage in industrial applications ever match the packaging markets?

Within the past few months, several papers have been given by authoritative experts which purport to answer these questions and more like them. Comprehensive summaries of these papers—with emphasis on predictions for the next five years—follow:

The Future Market for Plastics in Construction

By Thomas A. DeMarco, Mgr., Industrial Applications Dept., Monsanto Chemical Co.

The usage of plastics in the construction industry is relatively insignificant, when one is speaking of total material requirements. In 1958, the industry used 975 million lb. of plastics raw materials. This is approximately 22% of the total output of plastics, but only a 2 to 3% penetration of the total construction materials market.

Alkyds, vinyls, and phenolics are the dominant plastics in construction today. The major part of the total poundage goes into surface applications, with paint resins accounting for 381 million, plastics in wire coating for 125 million, and plastics in floor covering for 112 million pounds.

By 1975, it is expected that the country will be spending $23 billion for construction materials, out of a total new construction bill of $100 billion. By retaining its present share, and allowing for a modest increase through new applications, the plastics industry could reasonably expect to sell 2 billion lb. of building products by 1975. In order to capture a larger share of the market, plastics must move more into structural elements.

Further increase in usage will come only if there is a radical departure, manifested by complete freedom of shape and form, from conventional designs. Acceptance of new construction forms utilizing plastics will require a psychological change in the thinking of home buyers, municipal code authorities, financial institutions, and architects and engineers.

Economics and Trends in Rubber and the Newer, Rubber-Like Materials

By George R. Vila, Group Exec. Vice Pres., U. S. Rubber Co.

The United States in 1959 will use a predicted 1.65 million long tons of rubber, of which 66% will be synthetic. On a world-wide basis over the next 10 years, rubber consumption is expected to increase by two-thirds, and synthetic rubber use two-fold.

As the rubber industry moves progressively from a natural to a synthetic base, the demarcation line between plastics and rubber becomes more vague, and most rubber companies have entered or are investigating the plastics field. There are three broad reasons for this: 1) some processing techniques and equipment are nearly identical, in both industries; 2) many plastics have grown because of their invasion of markets previously served by rubber; and 3) plastics have led to many new applications, thus broadening the horizons of rubber.

The key to expansion for the rubber industry obviously lies in the field of polymer chemistry. One road of research in this field has led to neoprene, nitrile rubbers, SBR and the new "stereo-regular" polymers. The second has led to phenolics, polystyrene, vinyl, and many other plastics. As these roads converge, they are carrying the rubber industry into an area of new growth and diversification. **(To page 124)**

Plastics used in building construction

Resin type	1958 production[a] (millions of pounds)	Per cent in building end-use	Plastics in building (millions of pounds)
Cellulosics	141.4	0	0
Phenolics	460.6	33	155
Urea and melamines	324.2	21	66
Polyesters	113.9	17	19
Styrenes	695.4	20	140
Polyethylenes	864.0	13	110
Vinyls	821.4	25	207
Alkyds	338.3	70	238
Rosin modifications	120.3	23	28
Cumarone and petroleum polgs.	236.8	0	0
Acrylics	121.0	10	12
Miscellaneous	421.7	0	0
Totals	4,659.0		975

[a] Per U. S. Tariff Commission Report as revised in June, 1959.

Foam markets, million cu. ft. per year

	Estimated 1965 Potential	Estimated 1965 Consumption
FLEXIBLE		
Automotive	35	24
Furniture	21	15
Mattresses and pillows	72	50
Miscellaneous	14	11
	142	100
RIGID		
Industrial buildings	60	30
Domestic buildings	30	20
Equipment	30	15
Appliances	50	30
Miscellaneous	10	10
	180	105

Plastic Foams and Their Markets

By W. C. Goggin, Plastics Dept. Mgr., The Dow Chemical Co.

Polystyrene, urethane, vinyl and polyethylene foams have enjoyed the greatest commercial success to date. Other foams are beyond the basic laboratory stage and the next 6 years will certainly see new end uses, and more new foams.

Flexible foams find their major application in cushioning, and since this market has been well explored, it is felt that the most increased demand in the future may be in packaging, pipe insulation, acoustical uses, garment inner-liners and insulation, and specialty "fabrics."

Independent studies made in 1955 estimated the consumption of flexible foams (both plastic and latex rubber) in 1965 at 100 million cu. ft., based on a foam density of 6 lb./cu. ft. This figure takes in the automotive, furniture, mattress and pillow, and public seating, rug underlay and miscellaneous markets. In the light of 1959 knowledge, estimates in all but the mattress and pillow market indicate that 1965 consumption will match or exceed the independent study figures.

Total market estimates for rigid foams by 1965 indicate that 105 million cu. ft. will be used, or about 60% of the known potential. 1965 markets, and their estimated consumption in cubic feet, are: industrial building, 30 million (with close to 100% penetration in the area of cold storage insulation); domestic building, 20 million; equipment, 15 million; appliance, 30 million; and other markets, at least 10 million.

Hindsight and Foresight in Chemicals and Plastics

By John L. Gillis, Vice Pres., Monsanto Chemical Co.

The plastics industry is not yet a mature one, and improvements and refinements are constantly coming from the laboratories. Production in 1958 went to more than 4½ billion lb., a three-fold increase in the last 3 years.

As for the future, there are many areas where plastics will prove useful. In the construction field, the dollar value of plastics materials used should reach $2 billion a year in 1966. Plastics can extend the limit of possibilities in new construction, surpassing the advances in such traditional materials as wood and metal.

The most generally used growth forecast for plastics calls for a four-fold increase in the next 10 years. It should also be remembered that plastics have, in the past, outstripped all but the most visionary long-range estimates of potential, and that international operations in plastics are growing. This picture does by no means preclude the definite need for efficient marketing.

The walls once separating the various segments of the chemical industry are gradually breaking down as companies become more customer-oriented and offer more across-the-board services. It is essential that the industry remain flexible and strong enough to take the fullest possible advantage of the predicted future changes.

Plastics Industry Integration—How Far, How Fast?

By John W. LaBelle, Asst. to the Pres., Foster Grant Co. Inc.

The principle of integration in the plastics industry is fully established today and will continue, but inherent problems should be examined before such ventures are undertaken.

In "forward" integration, a producer of basic raw materials moves by steps into monomer production, then polymer, and perhaps even into processing. He will face such problems as the need for specialized technical knowledge, the demand for higher quality specifications, customer resentment of his competition, the establishment of a larger marketing organization, and the acquisition or training of sales and technical service personnel.

Integration "backward" from molder to raw material producer poses such problems as the acquisition and efficient use of capital, and the timing of the integration move. Marketing obstacles are not as serious in integration of such a nature; such problems are an important aspect of his business to begin with.

It is not foreseen that the plastics industry will be dominated soon by a few large petroleum companies and their petrochemical subsidiaries. In all probability though, the most prevalent integration in the near future will be an invasion of the monomer field from above.

Integration will undoubtedly occur more rapidly and to a greater extent in the older, well-established plastics. By and large,

only the inefficient and unbusinesslike will be hurt to any extent by integrated operations.

Plastics: Molding and Extrusion End-Use Markets for High Polymers Forecast to 1965

By J. K. Honish, Market Research Dept., Union Carbide Plastics Co.

The end-use markets in molding and extrusion accounted last year for about 33%, or 1.67 billion lb., of the total consumption of all plastics, a figure around 5.0 billion pounds.

By 1965, it is estimated that this share will increase about 69% to 2.8 billion pounds. This figures out to approximately 29.2% of an estimated total demand of approximately 8.1 billion pounds.

From this year to 1965, the largest rate of growth in molding end-uses will be seen in the packaging, transportation, and household and office product markets, in that order. In extrusion end-use markets, the growth leaders will be the construction, packaging, and appliance categories. In total poundage, both in molding and extrusion, the leading markets will be: appliance, consuming 431 million lb.; household and office products, 402.3 million lb.; and packaging, some 365 million pounds.

The olefins' share in the molding and extrusion end-use markets will be about 890 million lb. in 1965. The styrene and vinyl product complexes will follow with approximate volumes of 665 and 508 million lb. respectively.

The 69% increase in the molding and extrusion end-use markets by 1965 is somewhat lower than the corresponding 87% figure for the past 6 years. This suggests some leveling off, presumably because of partial saturation of specific markets.

End-Use Markets for Films

By D. D. Lanning, Dir. of Market Development and Customer Service Section, Film Dept., E. I. du Pont de Nemours & Co.

The 1959 market for films can be measured at nearly a billion lb. and almost ⅔ of a billion dollars, and there are no less than 26 films aimed at this market.

Packaging applications take up well in excess of 600 million lb. of this total. Cellophane accounts for 400 million lb., principally for overwrap. Plastic film with the largest volume concentrated in polyethylene, which takes up 180 million lb., is used primarily for bags, and skin as well as blister package applications.

Industrial, or non-packaging applications, will account for approximately 300 million lb. in 1959. There are about 10 major film types competing for this business, but PE and PVC films together account for about ⅔ of total volume. One-third of the total poundage is consumed by fabric replacement, construction, and agriculture applications.

Looking to the future, the market for packaging films is certain to reach the billion pound level by the mid-1960's. The leading plastic film in this market will be polyethylene, which with cellophane will take in the neighborhood 80% of the total market.

The outlook for non-packaging films is even more bullish, with an estimated 600 million lb. market by 1965 or thereafter. Films for outdoor applications have especially bright prospects.

End-Use Markets for Plastic Containers

By Clive Eustace, Market Analyst, Plax Corp.

Total consumption of plastics in the container field came to around 91 million lb. in 1958. The forecast for 1965 is 250 million lb., with the major part of the growth stemming from increased bottle applications. As an example, this year should see production of almost 400 million plastic detergent bottles using 32 million lb. of high density polyethylene. Related applications are expected to swell this total by several million pounds of resin.

Sheet formed and extruded containers consumed 7 million lb. of plastics in 1958, principally transparent cellulosics. Rigid molded containers consumed 60 million lb., by far the largest share of the total, with polystyrenes leading the way.

Twenty million lb., principally low density PE, went into squeeze bottles and collapsible tubes. Industrial shipping containers used a total approximately 4 million lb. of plastic in 1958.

The economics of plastic containers has improved, and will continue to do so in the future. This growth will be spurred by advances in manufacturing technology, emergence of new polymers and modifications of existing ones, as well as the fuller exploitation of design and color possibilities that have been found inherent in plastics materials.

Newer materials, such as polypropylene, the acetal resins, and biaxially oriented polystyrene sheet, look highly promising for certain future applications. High density PE, polypropylene, and perhaps other new polymers, should push total poundage for rigid bottles, tubes, and shipping containers to well over 100 million lb. by 1965.—**End**

Consumption of plastics for containers: 1958, 1965

Type of container	Millions of lb. of plastics
Sheet formed and extruded containers	7
Rigid molded containers	60
Squeeze bottles and collapsible tubes	20
Carrier bottles	0
Industrial shipping containers	4
Total plastic consumption—1958	91
FORECAST TOTAL PLASTIC CONSUMPTION—1965	250

Plastics in the product revolution:



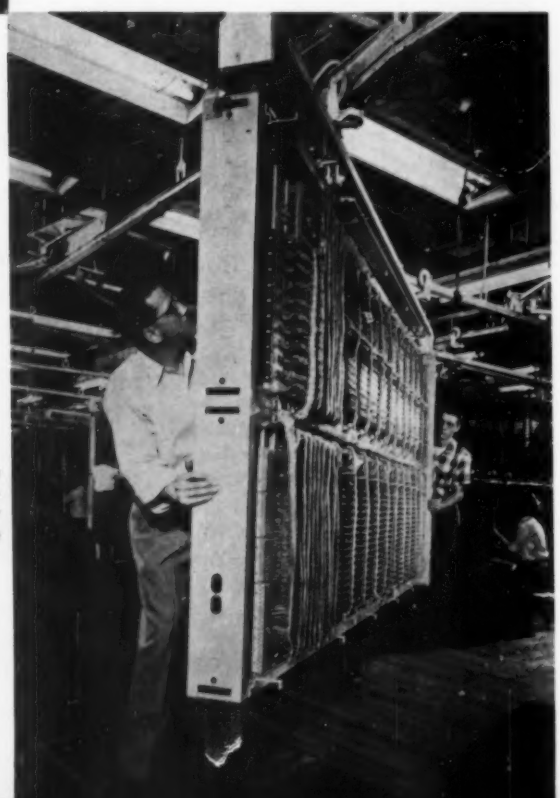
AMONG LATEST MODELS telephones is Call Director series, a phone-interoffice communication system combination. Housing, handset, buttons, wires, and many internal parts consume large quantities of plastics materials.

Alexander Graham Bell was issued a patent on the telephone in 1876, just 8 years after James Wesley Hyatt invented cellulose nitrate, thereby founding the plastics industries. Since then, telephones and their accessories such as cables, terminal boxes, relays have accounted for an estimated use of over a quarter of a billion pounds of plastics.

Currently Western Electric Co. spends more than $41,000,000 a year for plastics resins.

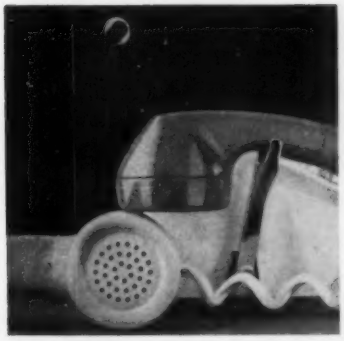
In 1917 the first army field telephone was brought out, and resulted in the first reinforced (then called filled) phenolics wherein fibers were blended with resins to make ear-pieces that could be dropped on concrete without breaking. This research was further refined in World War II and at least a couple of companies owe their origins to it.

In 1927 came a first "cradle" phone, with the ear-piece and talk-piece in one unit. It was called the "handset," and was partly made of metal and partly of compression molded of phenolic material. Variations of this phone were standard for a decade.



GENERALLY HIDDEN FROM VIEW of phone user, dial switch equipment in central telephone office uses vast volumes of plastics for wire insulation; 11¼-ft.-high bank above weighs approximately 300 tons.

THE TELEPHONE



THE COVER: The ghostly apparition in the background is the phone as it looked forty years ago. In the foreground, how it has changed—through proper usage of plastics materials.

Conceived in wood and metal, today's phone is one of the heaviest users of plastics. Since its introduction 100 millions phones ago, it has consumed one-quarter billion pounds of resin.

In 1930 two things happened. A young man named Henry Dreyfuss, an industrial designer, was engaged by the Bell System to help make telephones more functional and more beautiful. With most generous use of plastics he helped to redesign the instrument.

The other thing was the introduction of cellulose acetate. Later in the '30's were to come butyrate and other cellulosics.

The next significant year is 1937 which saw the bell-box eliminated and the parts in it newly reposing in the base of the telephone instrument. Again the base housing was metal, the speak-and-hear piece black phenolic.

The first injection molded telephone housings were produced in 1940. Butyrate was the "standard" material, with ethyl cellulose and cellulose propionate specified as alternate materials; cellulose acetate was for color telephones, requested then only by decorators. In 1959 more than half the telephone instruments produced were colored.

World War II put everything back on an austerity basis in black, and curtailed for civilian use. Again, as in the 1917 war, research money was spent on military communications. Prior to the war Western Electric was working on new cable coatings (polyethylene was a development of the war) after the war came new concepts of automation, including push-buttons, which may eventually replace the dial.

The now universally used "500 set" telephone was first announced in 1949, being the first designed and engineered for plastics, and in which no internal parts are mounted on the housing. It was first specified in butyrate, with propionate, and ethyl cellulose as alternatives. Today the main production material is ABS polymer, which was not made in 1949. The 500 set was 5 years from design to mass production. It has now been 10 years in service, and has been eminently satisfactory.

Both designers and engineers have been working for the past decade on new ideas. Among the latest to be translated from drawing-board dream into reality are the Call Director, a pushbutton business phone introduced in 1959, and "The Princess," a small, light-weight oval-based phone now making its appearance in selected areas.

The whole trend is towards the complete system, which means two or more instruments per home. And the whole trend in use of plastics in telephones is toward better materials, simpler, more functional design, and gorgeous color.—End



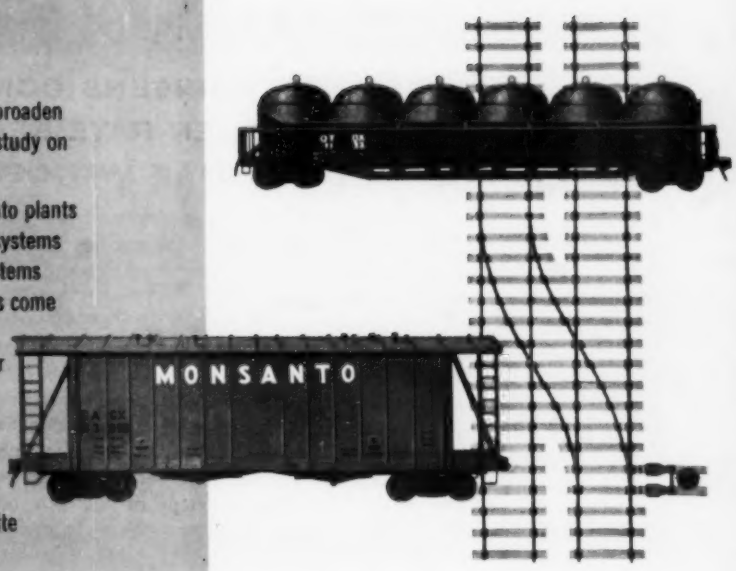
PRINCESS PHONE, available in five colors—until recently, most phones came in black only—is just being introduced by the public, relies heavily on plastics for its beauty, efficiency.

To "Bulk" or not to "Bulk"?

As part of Monsanto's comprehensive program to broaden and facilitate the general use of plastics, a 5 year study on the question of bulk handling was just completed.

This study drew on practical experience in Monsanto plants and in the plants of customers. The popular bulk systems were thoroughly examined and evaluated; new systems were developed and explored. Out of the study has come "A Report to Management on Bulk Handling", a valuable guide to manufacturers in reaching their individual decisions. Out of this study have also come bulk handling services which are shipping millions of pounds of Monsanto Polyethylene, Lustrex styrene, and Opalon vinyl.

If you would like a free copy of the full report, write to Monsanto Chemical Company, Plastics Division, Room 713, Springfield 2, Mass.

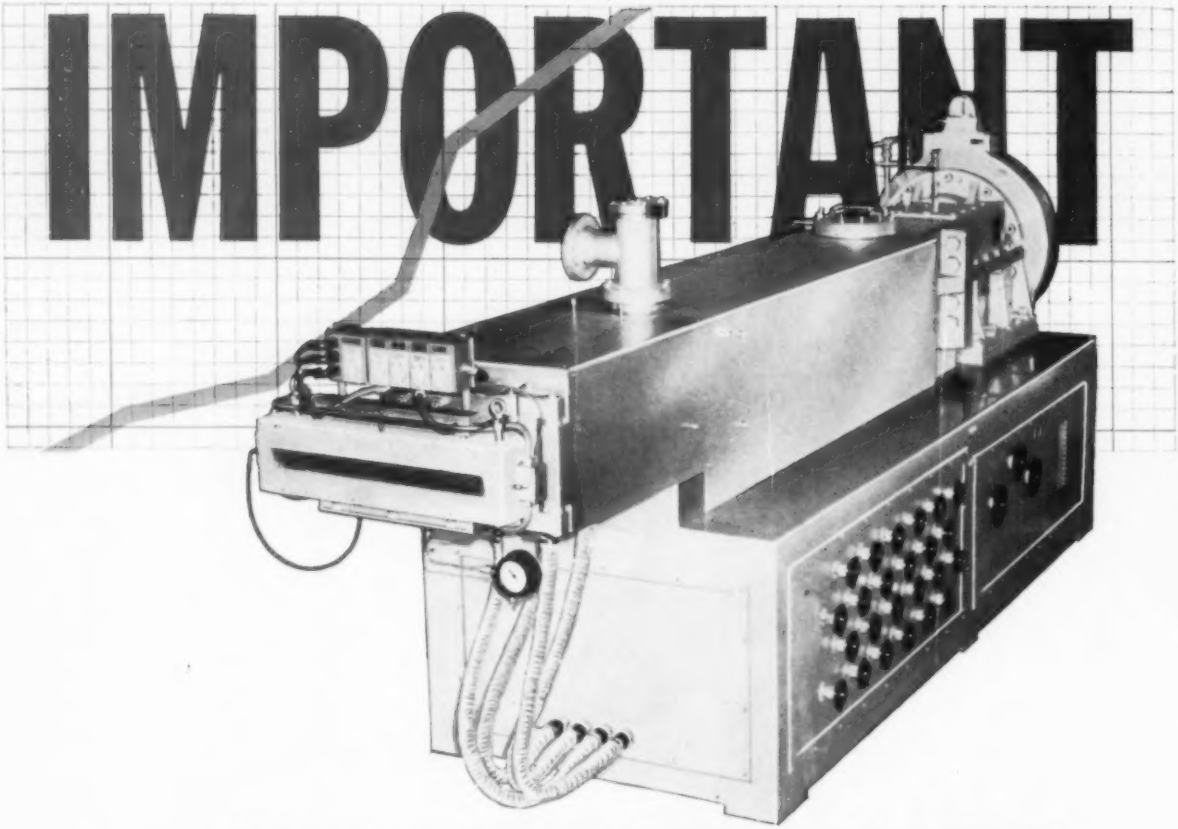


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IMPORTANT



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There is a potent reason for this pattern of performance—the limitless combination of flight characteristics on the unique dual worms which work so efficiently for so many famous plastics manufacturers. None can deny the eagerness with which each WEI machine takes its place on these trademarked production lines. It has a right to be confidently proud for it is backed with the most comprehensive research experience and enthusiastic engineering team any production-planning executive could ask for in *his specialized equipment supplier*. It was built to produce more with greater speed and with such substantial power, space and labor savings that it can be the "fair-haired" friend of finance executives on every hand. We would appreciate an opportunity to prove the important dual worm advantages to you . . . to prove it in the laboratory . . . and on the production line where profits are made . . . not just promised.

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MANUFACTURERS OF PROCESSING EQUIPMENT FOR THE CHEMICAL INDUSTRY

George R. Smoluk, Engineering Editor

PLASTICS ENGINEERING*

PROCESSING • FABRICATION • PRODUCT DESIGN • TOOL AND EQUIPMENT DESIGN

MACHINERY FOR PLASTICS

Domestic machinery sales boom while exports fall off

1959 has been a good year for machinery manufacturers. Recovering rapidly from the effects of the recession in 1958, domestic sales of injection machines jumped a whopping 54%; extruders were up 23%; vacuum forming machines rose 42%; and blow molding machines showed a five-fold increase.

Demand for injection equipment was mainly for machines 18 oz. and smaller. Sales in this category amounted to about 91% of all sales. This size distribution pattern of sales has now been the same for the past three years, machines between 2.5 and 7 oz. accounting for about 29% of all sales.

Sales of extruders were spread over the middle range in terms of size, with 83% of the machines sold having screws with diameters greater than 1.7 up to 6.5 inches. Preference for machines between 1.7 and 3.2 in. in diameter has persisted over the past 3 years. These accounted for one third of all extruders sold.

Thermoforming machines also had record sales, showing a pronounced trend toward smaller machines in terms of heater area. Whereas sales of machines of 6 sq. ft. area or less represented about 50% of all sales in 1957, this same category currently accounted for about 72% of total machine sales. Most popular sizes, about 49% of all machines sold, were 3 sq. ft. or less.

With all the enthusiasm shown for the blow molding technique at all levels of the plastics industry, no one was surprised to see sales of blow molding machines chalk up a 500% increase. Since 1959 was the first year in which we surveyed this field of machinery, and since no standard method of classifying the machines has as yet become established, information is not available on the capacity of these machines. In addition, although we requested information concerning types, i.e., whether the machine as sold came as a complete unit or whether it required the additional purchase or possession

TABLE I: Sales of injection molding machines

NUMBER OF MACHINES

Nominal shot Capacity, oz.	Domestic			Export		
	1957	1958	1959	1957	1958	1959
2.5 or less	339	262	363	8	6	9
2.5+ to 7	292	286	497	20	10	13
7+ to 10	55	92	163	7	10	7
10+ to 18	231	256	378	6	14	8
18+ to 29	38	36	73	2	2	2
29+ to 55	25	33	34	5	4	0
over 55	15	35	35	4	3	3
All sizes	995	1000	1543	52	49	42

TABLE II: Sales of Extruders

NUMBER OF MACHINES

Nominal screw Diameter, in.	Domestic			Export		
	1957	1958	1959	1957	1958	1959
1.7 or less	99	123	134	18	21	13
1.7+ to 3.2	283	249	333	60	44	43
3.2+ to 4.2	144	190	232	46	35	31
4.2+ to 6.5	181	178	261	50	39	28
over 6.5	49	67	35	7	9	5
All sizes	756	807	995	181	148	120

*Reg. U.S. Pat. Off.

TABLE III: Sales of thermoforming machines

NUMBER OF MACHINES

Heater Area	Domestic			Export		
Sq. Ft.	1957	1958	1959	1957	1958	1959
3 or less	126	165	230	12	5	14
3+ to 6	32	58	111	2	1	2
6+ to 12	106	68	82	5	4	2
12+ to 18	15	21	13	1	0	0
18+ to 30	35	15	41	4	0	2
Over 30	1	6	12	1	0	0
All sizes	315	333	474	25	8	20

TABLE IV: Sales of Blow Molding Machines

NUMBER OF MACHINES

Type	Domestic			Export		
	1957	1958	1959	1957	1958	1959
Used with extruder	—	4	31	—	7	0
Self contained	—	12	49	—	0	0
All types	—	16	80	—	7	0

TABLE V: Sales of compression presses

NUMBER OF MACHINES

Nominal Size	Domestic			Export		
Tons	1957	1958	1959	1957	1958	1959
25 or less		426	456		9	14
25+ to 50		68	88		2	4
50+ to 100		78	111		1	0
100+ to 200		42	39		0	0
200+ to 300		6	10		0	0
300 and over		1	25		0	0
All sizes		621	729		12	18

of an extruder to feed the machine, the responses indicate that there may have been some misunderstanding on this point, and the breakdown in Table IV may not be entirely valid.

Compression

An attempt was made in 1959 to include compression presses as part of our annual machinery survey. Time did not allow accurate estimates of the machines already in the field so an estimate of operable units was not made. However, the figures received on 1958 sales and 1959 estimated sales are presented in Table V. It is apparent that compression presses also enjoyed a sizable increase in sales: they were up about 18%. Most popular were the presses up to 25 tons, with presses in the 50- to 100-ton range a lagging second. These two categories accounted for about 78% of all sales.

Export

Sales of injection machines, extruders, and blow molding equipment for export continued to decline in 1959. This change is not wholly unexpected, considering the upsurge in foreign machine development that has been taking place lately. In addition, changes in the design of foreign machines, such as extrusion-injection molding machines and other advances in design, may also be influencing foreign purchasers to buy these machines at home.

In contrast to the decline of the above machines, sale of American thermoforming machines and compression equipment abroad have shown an increase—but no one seems to know the answer to this paradox. However, in view of the order of magnitude of the figures, it is unlikely there is any significance in this change.

Sources of data

To compile the data shown in the tables, questionnaires were sent to all the known manufacturers of the equipment reported in this article. Each was asked to list the actual sales made in 1958 and furnish an estimate of the 1959 sales. The 1958 figures were used to check and correct last year's figures and the 1959 estimates were totaled as received. This procedure differed from that used last year, in that the current estimates were not adjusted downward by 10% as in last year's report. The recheck of prior 1958 estimates against the actual sales reported for 1958 this year did not indicate that a 10% adjustment of the figures downward produced a more accurate estimate. As a result, since the figures shown for 1959 are estimates they may be in error by about ±10 percent.

Consistent with our prior reports on machinery sales, the number of operable machines in the field was estimated by arbitrarily assigning an average life of 12 years to an injection machine and 10 years to an extruder. All machines older than this were as-

TABLE VI: Operable machines in the United States

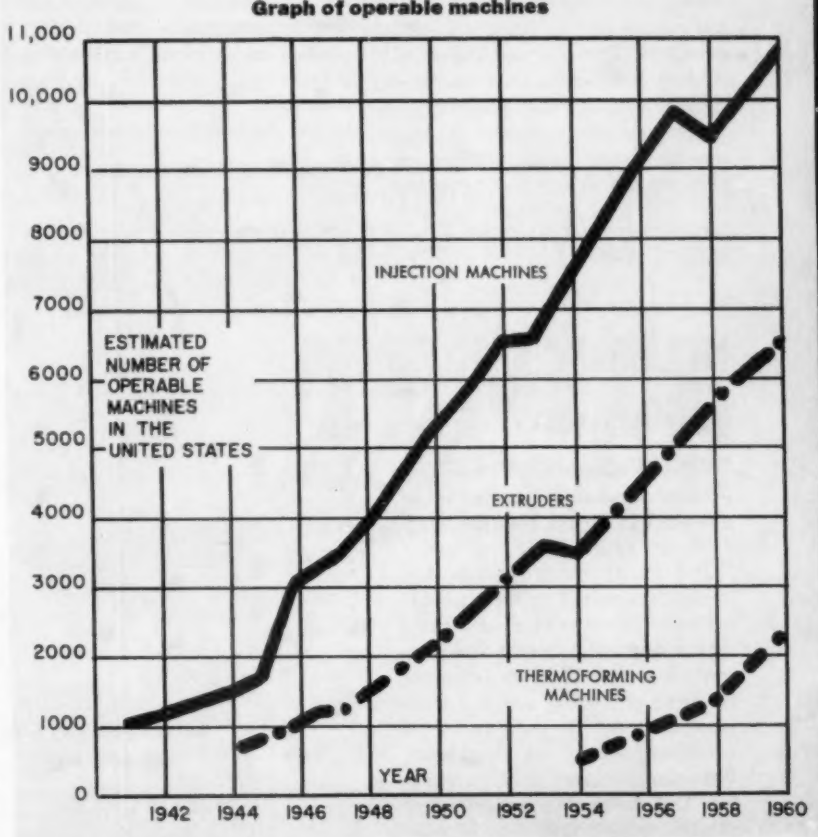
	1941	1944	1947	1950	1953	1956	1957	1958	1959
INJECTION MOLDING MACHINES									
Year end cumulative machines sold	1000[a]	1410	3395	5272	7570	10479	11474	12474	14017
Machines 12 years old or older	—	—	—	—	1000	1410	1656	3075	3395
Operable machines	1000	1410	3395	5272	6570	9069	9818	9309	10622
SCREW EXTRUDERS									
Year end cumulative machines sold	—	650[a]	1269	2164	3553	5591	6347	7154	8149
Machines 10 years old or older	—	—	—	—	—	1107	1269	1556	1900
Operable machines	—	650	1269	2164	3553	4484	5078	5598	6249
SHEET THERMOFORMING MACHINES									
Machines shipped	—	—	—	—	—	970[b]	1285	1618	2092
BLOW MOLDING MACHINES									
Machines shipped	—	—	—	—	—	—	—	16	80

sumed to have been scrapped. Obviously, there are many machines which have been in service for longer periods of time; however, the assumptions above serve to recognize to a reasonable extent the effects of machine retirement on the estimate of machines now operating in the field.

Summary

In view of the increased sales of machinery reported above, coupled with the increases in the sale of most all materials being reported this year, the plastics industry is far from finished with expansion. The capacity for the production of plastic products is probably even greater than that indicated by the number of machines listed here, since our survey does not include domestic purchases of machines from foreign equipment suppliers. Also, machine capacities are often further increased by auxiliary equipment added later, such as pre-plasticators, as well as by improved production techniques. All factors considered, the future for the plastics industry as it appears at the conclusion of 1959 is rosy indeed.—**End**

Graph of operable machines



1959 Engineering Highlights

Brief reviews of important advances in plastics engineering in the past year

Many advances in plastics processing knowledge were made in 1959 and reported in the literature. Obviously, all could not be included in this review. The basis for selecting the articles listed below was our opinion on the novelty, depth of coverage, and the contribution made to the progress of the ever-growing fund of plastics knowledge. Particularly noticeable in reviewing the literature was the fine quality of many articles appearing in the foreign journals from our colleagues in the industry.

The abstracts presented here were prepared from articles appearing in some 30 domestic and foreign periodicals in the plastics and allied fields. Books pertinent to the same topics and published during 1959 have been reviewed currently during the year and are not included in this selected roundup. Articles on Technical Section subjects (such as materials, testing, and chemistry), unless they relate directly to plastics processing or application are also omitted. Interested engineers will find brief comments on such articles in "The year 1959 in review," p. 151.

Design and application

"The comparison of time dependent mechanical properties of plastics," by ***Bryce Maxwell***, *SPE J. 15*, 480 (June 1959).

The utility of a dynamic test in rapidly evaluating the time dependent characteristics of a plastic are discussed. Such a test permits the controlled variation of the time of loading and test temperatures over a wide range of conditions and allows the characterization of materials. By obtaining the dynamic properties of plastics under conditions of controlled strain magnitude, the strain limit of confidence in the data can be determined. This is called the limit of linear viscodistic response and can be used as an important engineering design criterion.

"Plastics in railway rolling stock," Staff Article in *Brit. Plastics 32*, 136 (April 1959).

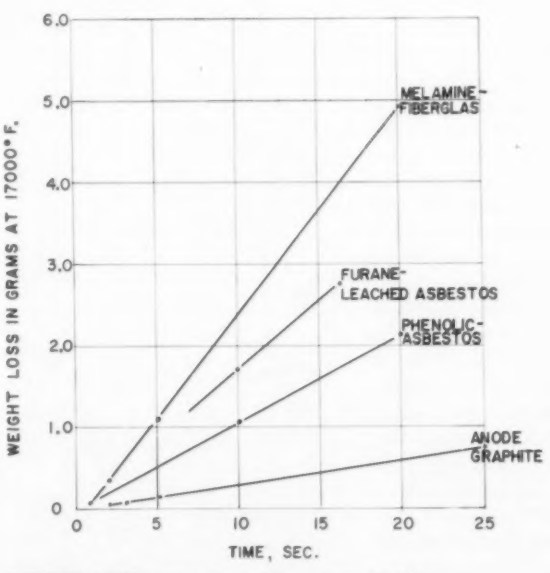
Describes the use of plastics in railroad cars and engines. Uses are engine-cab domes, roofs, lavatories, steps, doors, etc. Manufacturing techniques and typical structural designs are discussed.

"Gaseous combustion products from plastics," by ***E. H. Coleman***, *Plastics (London) 24*, 416, (Oct. 1959).

With the growing concern about the flammability of plastics, this article is valuable in selecting plastics for various applications. A table listing several of the more commonly used plastics is presented showing typical analysis of the gases generated as these plastics burn. Another table lists several of the gases which may arise from plastics fires and lists their toxicological effect. It is concluded that carbon monoxide is the major hazard from the gases liberated by burning because it is present in the greatest quantity.

"Behavior of reinforced plastics at very high temperatures," MPl, Part II, *36*, 137 (April 1959), by ***I. J. Gruntfest, L. H. Shenker***, and ***V. N. Saffire.***

A systematic study of the physical nature of the damage to selected reinforced phenolic plastics in high temperature environments is reported. The tests were made in the plasma of a water-stabilized arc at temperatures up to 23,400° F. High organic content compositions are shown to perform best at the highest temperatures, while high inorganic content materials are superior below about 6000° F. Examination of the surfaces and cross-sections



WEIGHT LOSS versus time for various plastic compositions at 17,000° F. ("Behavior of reinforced plastics at very high temperatures, II)



for a tough sign plastic...**BUTYRATE**

Durable signs, with letter faces vacuum-formed from sheets of Tenite Butyrate plastic, now identify J. I. Case Co. dealers to tractor, farm implement and industrial equipment buyers throughout the world.

Butyrate sheet's brilliant luster gives these letters an eye-catching, eye-pleasing appearance in daytime; and its excellent light transmission and diffusion properties provide long-distance legibility when backlighted at night.

These properties, while important, were not the main reason for choosing Butyrate. Superior toughness was the big advantage Butyrate sheet offered over other plastic sign materials. Toughness was a "must" with Case, because the signs would have to endure considerable rough handling and abuse enroute to dealers, particularly those located in foreign countries. And even after reaching an overseas destination safely, there was still the possibility that inept handling by unskilled labor could result in breakage during installation. By specifying Butyrate, Case obtained maximum protection against breakage and costly, time-consuming replacements.

Another point in favor of Butyrate was its proved outdoor durability. Despite severe climates, hot or cold, the special weather-resistant formulation of Tenite Butyrate plastic used in these signs will keep them attractively bright for years.

Outdoor signs are a logical use for Tenite Butyrate, and sign men turn to this plastic when they need a tough, durable material. However, the applications for Tenite Butyrate cover a wide range of consumer and industrial uses. For more information on the performance advantages and easy-forming properties of Tenite Butyrate, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.



TENITE
BUTYRATE
an Eastman plastic

J. I. Case Co. signs are manufactured by Everbrite Electric Signs, Inc., 1440 N. Fourth St., Milwaukee 12, Wisc. Letter faces are vacuum-formed from extruded sheet of Tenite Butyrate plastic. Sheet is extruded by Southern Plastics Company, 408 Pendleton St., Columbia, South Carolina.

of damaged specimens reveals some distinct relationships between composition, exposure conditions, and nature of the surface, as well as three different types of damage. The significance of steady state conditions as related to these experiments is also discussed. The techniques described may be useful for predicting the behavior of materials in severe thermal environments, or in estimating the conditions to which they have been exposed.

"Theory of mechanical breakdown and molecular orientation of a model linear high-polymer solid," by ***C. C. Hsiao,*** *J. App. Physics, 30,* 1492, (Oct. 1959).

A mathematical analysis of the effect of orientations on the fracture strength of polymers. By using a hypothetical model, the author predicts a six-fold increase in the fracture strength of an oriented polymer as compared to one non-oriented. Experimental data presented compare favorably with the calculated curves.

"The use of plastics materials in electric cables and associated products," by ***J. D. S. Henchcliffe,*** *The Plastics Inst. Trans. and J., 27,* 68 (April 1959).

Starting with a discussion of the various plastics used in the manufacture of cables, this article continues with descriptions of the manufacturing techniques used and the various types of cables designed for different purposes. These include power cables, aircraft wiring cables, railway and telephone cables, and radio and TV cables. In addition, repairs of plastic cables are discussed.

"Building with plastics," by ***Prof. Dr. E. Brandenberger,*** *Plastica, 12,* 388 (May 1959). In German.

The article analyzes the importance of understanding fully the limitations of plastics materials as load bearing elements in building construction; explains why manufacturers of plastics materials for building uses must fully characterize their products in terms of mechanical, thermal, and chemical properties; and why designers and builders must completely understand the limitations of each plastics material and must evolve new design and construction concepts to exploit the good properties and overcome the limitations. Graphs illustrate the behavior of some structural plastics materials as functions of temperature, aging; and chemical resistance.

"The biological deterioration of plastics," by ***H. J. Huech,*** *Plastica, 12,* 24 (Jan. 1959). In Dutch.

A roundup of the effects of biological influences on the deterioration of plastics.

"What materials will we need in 1970," *ASTM Bulletin,* No. 240, 28, (Sept. 1959).

Based on the Sixth Annual Forecast of Trends and Requirements prepared by the AeroSpace Industries Association, this article describes the temperature resistance for several plastic materials which will be required in the coming Space Age. Present levels of temperature resistance are compared to what will be required. It is interesting that some metal to metal adhesive requirements will need to exceed those of several present metals.

"Novel light-weight moldable permanent magnet material," by ***L. I. Mendelsohn*** and ***R. S. Norman.*** *Journal of App. Physics, 30,* Supplement Issue, 142S. (April 1959).

A new, lightweight moldable permanent magnet material is described. Composed of iron-cobalt particles and a thermosetting resin, the powdered material can be oriented and pressed into complex shapes at high production rates on automatic presses. Developed by the General Electric Co. Instrument Dept., the material has an excellent application in moving magnet instrument motors.

"A review of stress cracking in polyethylene," by ***J. B. Howard,*** *SPE J. 15,* 397 (May 1959).

A comprehensive discussion of the mechanisms, variables and material and end-use tests involved in stress cracking. Round-robin test results from several laboratories are also included. It was found that the major variables in stress cracking of polyethylene were 1) average mol. wt.; 2) mol. wt. distribution; 3) crystalline content; 4) crystallite and/or spherulite size; 5) levels of applied stress and strain; 6) amount of orientation; 7) chemical nature of the environment; and 8) temperature. An excellent reference for designers using polyethylene.

"Drinking water pipes of low pressure polyethylene," by ***K. Richard*** and ***G. Diedrich,*** *Kunststoffe 49,* 516 (Oct. 1959). In German.

The pipe designer will find this article loaded with useful data, and of immense value in understanding the use of low pressure PE for pipe. Many graphs on the creep behaviour of this pipe and recommended safety factors are included. Definitely must reading for users and manufacturers of polyethylene pipe.

"Reinforced plastics for rocket motor applications," by ***G. Epstein*** and ***J. C. Wilson,*** *SPE J., 15,* 473 (June 1959).

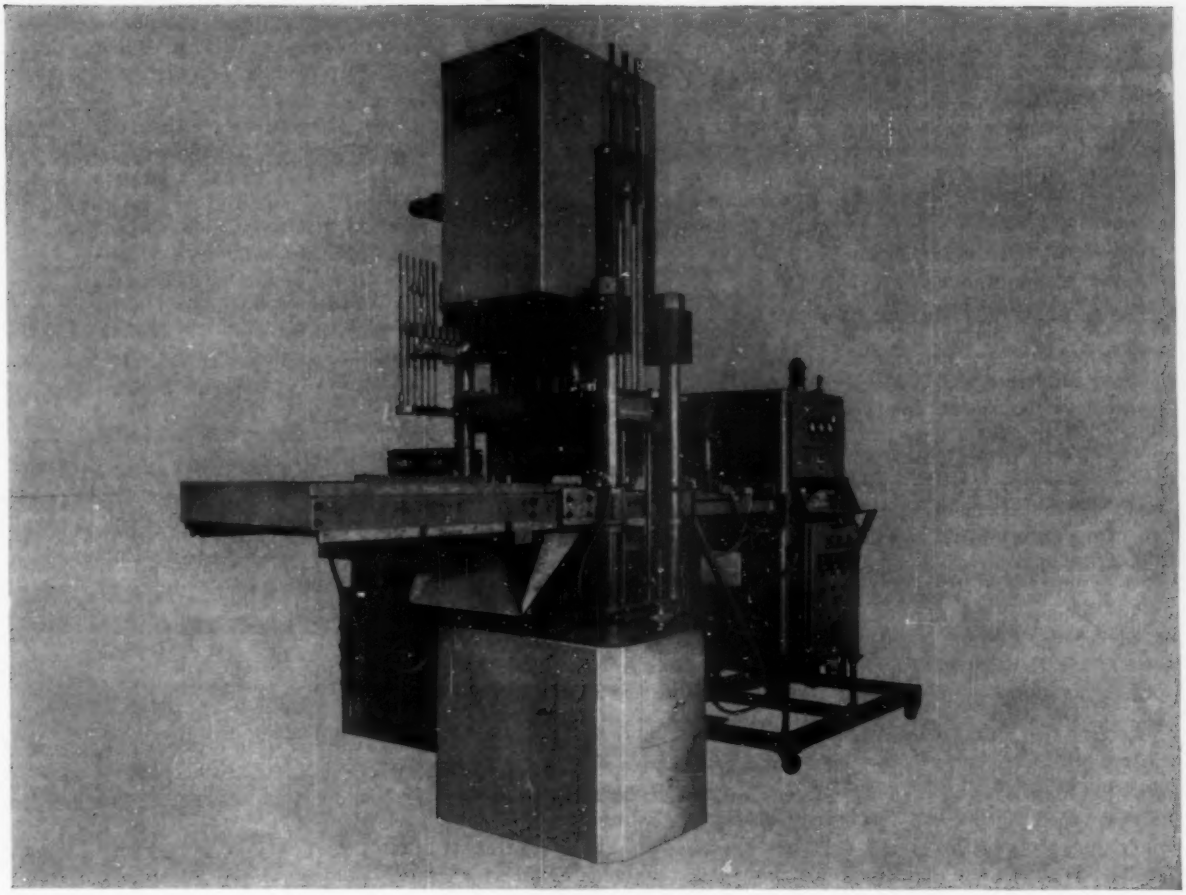
A survey article on plastics missile technology. Included in the article are an historical background, theory, a discussion of fillers and binders, recent developments, and test methods for the evaluation of plastic compounds suitable for missile work. Good for bringing the engineer up to date on plastics missile work.

"Fastening of glass reinforced plastics," by ***Marshall D. Weiss,*** *Prod. Eng.-Design Digest Issue* 368, *30,* (Mid-Sept. 1959).

Several reinforced plastic applications must have mechanical joints and connections. This article discusses bolted, riveted and screw connections. A wealth of detailed design data is contained in nine tables to aid the designer in specifying the size and type of fasteners to be used.

"Glass Fibre Reinforced Plastics in the Chemical Industry," by ***F. F. Jaray,*** *Plastics (London) 24,* 483 (Dec. 1959).

Five rules to observe in designing reinforced plastics for



Now from STOKES...NEW LINE OF COMPLETELY AUTOMATIC TRANSFER MOLDING PRESSES

Completely automatic transfer molding presses are now a reality! Stokes' new line contains features developed and proved during 25 years of automatic compression molding experience. The new presses range from 25 tons to 300 tons capacity. Already, 10 have been installed and are providing industry with new economies of operation.

Here is why these presses have gained immediate acceptance and why they can be important to you . . .

- they meet industry's need for *fully* automatic transfer molding
- their extremely fast transfer and clamping speeds
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- positive seal between feed and comb . . . parts can't fall back into mold
- complete mold protection
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- easily modified for use as automatic compression presses

All these features—and many more—mean new efficiencies never before possible. The new line is one more example of Stokes continuing leadership in the molding equipment field.

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chemical service: Keep load carrying structures dry; apply roving unidirectionally; prestress fibers while immersed in resin; fibers should only carry tensile loads; and fiber deposition should be done mechanically to avoid human error.

"Glass fiber sleeve-springs for high energy absorption," by ***K. Maier,*** *Prod. Eng.-Design Issue, 30,* 61 (Aug. 17, 1959).

Composed of plastic coated windings of glass fibers, a cylindrical sleeve has shown amazing ability to absorb the energy from masses moving at high velocity. Article discusses design and characteristics of these springs used in an experimental tool for driving fasteners.

"How to design flat reinforced plastic springs," by ***L. A. Heggernes,*** *Prod. Eng. 30,* 74 (Nov. 9, 1959).

The key advantage of reinforced plastic springs over steel is their high-energy absorption capacity per unit volume. Epoxy resins are generally used. This article describes the procedure for designing a plastic spring and gives examples of successful uses of these springs.

"Hostalen PPH a new material for ladies' heels," by ***Dr. Felix Schuelde,*** *Der Plastverarbeiter, 12,* 265 (July 1959). In German.

The suitability of polypropylene for the manufacture of ladies' heels is compared with other materials used for this application, based on specially developed test methods. The article also discusses aspects of importance to the shoe manufacturer, especially methods of fastening heels, and general processing techniques for the manufacture of plastics heels.

"Polypropylene as a mold material for resin casting," by ***A. R. Faurs*** and ***R. Clark,*** *Brit. Plastics 32,* 430 (Sept. 1959).

Polypropylene molds have been found to release freely from both epoxide and polyester resins and have several advantages over other materials. Among the advantages are that the number of castings which can be obtained from one set of molds is greater than with PVC or silicone rubber molds. Inexpensive and accurate molds used for the encapsulation of electrical components can be injection molded and the more rigid polypropylene has a dimensional accuracy approaching that of metal molds and avoids the use of a release agent. Cure temperatures up to 150° C. can be used.

"Polyester film—how long does it last?," by ***W. McMahon, H. A. Birdsall, G. R. Johnson*** and ***C. T. Camille,*** *Mat'ls in Design Eng. 49,* 94 (Feb. 1959).

Curves, based on estimated chemical reaction rates, give the combination of temperature, time, and humidity which will probably reduce the tensile strength of polyethylene terephthalate films to about two thirds of its original value. Tensile strength is used as a criterion for durability since it was found most sensitive to the changes.

"Semi-rigid PVC," by ***U. Jacobson,*** *Brit. Plastics 32,* 152, (April 1959).

PVC with a plasticizer content of 0 to 20% has generally been neglected in the literature since small amounts of plasticizer generally yield brittle PVC compounds. It has been found that the most desirable properties in PVC in finished products are developed by using feebly solvating plasticizers such as sebacates and adipates. Much still has to be learned about semi-rigid PVC but indications are it will be possible to exploit the good qualities of this material as more knowledge becomes available.

"Heel lift has built-in spring pin fastener," *Ind. Design 6,* 75. (Oct. 1959).

This method of attaching lifts on women's shoe heels solves the problem of nailing lifts on plastic heels. The lift is attached to a tubular spring-pin which slides into a hole in the shank of the heel. In addition to eliminating nailing, the spring pin also serves to strengthen the heel shank on thin high heels.

"Chemical problems in printed wiring," by ***E. B. Sanbestri;*** **"Electroplating and metallizing printed wiring,"** by ***J. F. Dytre;*** **"Factors affecting occurrence of flaws in etched wiring,"** by ***R. V. Andes;*** **"Regenerable etchant for copper,"** by ***L. H. Sharpe*** and ***Paul D. Garn;*** **"Silver migration and printed wiring,"** by ***S. W. Chaikin, J. Janney, F. M. Church*** and ***C. W. McClelland;*** **"Contamination and electrical leakage in printed wiring,"** by ***S. W. Chaikin, C. W. McClelland;, J. Janney,*** and ***S. Landsman.***

A series of papers on the chemical factors in problems arising with printed circuits, *Ind. Eng. Chem. 51* (March 1959).

"Failure mechanisms in glass-fiber reinforced plastics," by ***M. B. Desai*** and ***F. J. McGarry,*** *ASTM Bull.* No. 239, 76 (July 1959).

The authors' experiments show that failure in fibrous-glass-reinforced plastics begins with internal cracking caused by yarn crimp resulting from the fabric weave and because of resin brittleness in tension and shear. Such cracking can be eliminated by using crimpless fabrics, if the applied load is in the fiber direction, or by using more ductile (i. e. "flexible") resins.

"How and when to use plastic pipe," by ***G. Sorell,*** *Chem. Eng. 66,* 149 (March 23, 1959).

Here is a comprehensive handbook for would-be users of plastic pipe. General pros and cons are listed, and pipes made of all available pipe plastics are discussed. There are data tables covering chemical resistance; cost of pipe and installation; dimensions of various nominal pipe sizes; physical and mechanical properties; allowable operating stresses, pressures, and temperatures for 2-in. pipe; creep; and joining and fabricating.

If plastic coatings won't adhere to metal, the fault may lie in the processing of the plastic—not in the basic properties of the resin itself, according to **"When resins won't stick,"** *Prod. Eng. 30,* 13, (Sept. 7, 1959). Polyethylene, a non-stick material, will cling to metal and may actually be used as an adhesive if low molecular weight components

Thermaflow® Tips

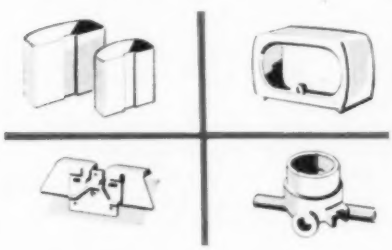
News about high-strength molding compounds

Atlas Powder Company, Wilmington 99, Delaware
In Canada: Atlas Powder Company, Canada, Ltd., Brantford, Ont.

THERMAFLOW
ATLAS

New Thermaflow 105 saves 20% over other high-strength plastics

If you've been interested in using high-strength plastics in products now made of metal or conventional plastics—but found the price tag too steep . . . here's news. New Thermaflow 105 reinforced polyester premix gives you a balance of strength, moldability, surface finish, chemical and electrical properties—at a cost about 20% lower than other high-strength compounds. It's the best buy yet in terms of strength per dollar.



An "idea" material

This new combination of performance and price opens up endless new design possibilities. Use it for new quality and economy in TV and radio cabinets, air conditioner housings, appliance parts, instrument cases, tubes, buckets, panels, tanks. You name it . . . we'll help you do it.

Take a look at the characteristics listed here. Remember—you'll get maximum benefits when you design to utilize its high-strength, corrosion resistance, and consistently high quality to the utmost. It's easy to use, too . . . pulls apart readily to load in molds, and has long stability in storage.

MOLDED PROPERTIES

Specific gravity	1.87
Flexural strength, psi	
*ASTM bar	20,000
**Cut specimen	16,000
Flexural modulus (psi x 10^6)	1.6
Izod impact-notched, ft./lbs./in. notch	
*ASTM bar	12.0
**Cut specimen	4.5
Compressive strength, psi	18,000
Heat distortion point, 264 psi	>450° F.
Barcol hardness	65
Water absorption, %	
24 hours @ 23° C.	0.14%
24 hours @ 100° C.	0.75%

*ASTM bar—Test results achieved with a sample molded under ideal laboratory conditions to achieve maximum strength.

**Cut specimen—Test results achieved on a number of samples cut from molded parts at random direction to any possible glass alignment. Results reported are the average of several tests.

NOTE: Common practice reports test results in terms of the maximum values available under ideal conditions "ASTM bar" figures are listed here to permit comparison of Thermaflow 105 with other similarly reported materials.

ELECTRICAL PROPERTIES

Arc resistance, sec.	130 sec.
Dielectric strength (⅛" thick)	
v/mil short time	230 v/m
step by step	210 v/m
Dielectric constant (1 mc.)	5.05
Dissipation factor (1 mc.)	0.009

STRENGTH RETENTION

	Flexural Strength, psi	Flexural Modulus x 10^4	Appearance
Original sample	16,000	1.58	—
24 hours H_2O @ 100° C.	After Test 13,400	After Test 1.21	excellent
24 hours 10% boiling NaOH	13,800	1.09	good
24 hours 10% boiling HCl	10,500	0.87	surface good—pigment bleached white

Price Schedule (f.o.b. Wilmington; Net 30 days)

Standard Colors: grey, tan, black

1 carton — (80 lbs.)	— $ .64/lb.
5 cartons — (400 lbs.)	— .48/lb.
24 cartons — (1,920 lbs.)	— .42/lb.
120 cartons — (9,600 lbs.)	— .41/lb.
252 cartons — (20,160 lbs.)	— .40/lb.
less than 1 carton	— 1.00/lb.

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Write for catalog of Thermaflow materials, and for case histories of their use by leading molders.

and oxygenated compounds are removed. These components form surface films on the resin which interfere with adhesion and result in weak boundary layers, much as oxides do on the surface of many metals. When objectionable impurities are removed, peeling tensions as great as 91 oz./in. have been observed and printability is improved. Neither tensile strength nor melting range of the resin is significantly altered by the removal of the low m.w. fraction.

"29 blind-side fasteners," by ***F. Strasser,*** *Prod. Eng.—Design Issue 30,* 66, (July 20, 1959).

A summary of both home-made and commercially available fasteners and techniques. Should be useful to plastics designers with fastening decisions to make.

"The crystalline and morphological structures of polyamides," by ***A. Muller*** and ***R. Pfluger,*** *Plastics (London), 24,* 350 (Sept. 1959).

A comprehensive discussion of crystallinites in nylon resins and its influence on molded and extruded products. Crystallinity of polyamides can vary by as much as 30% depending on the type of processing, and moldings differ so much in nearly all their properties that it is important for the processor and user to bear this phenomenon in mind.

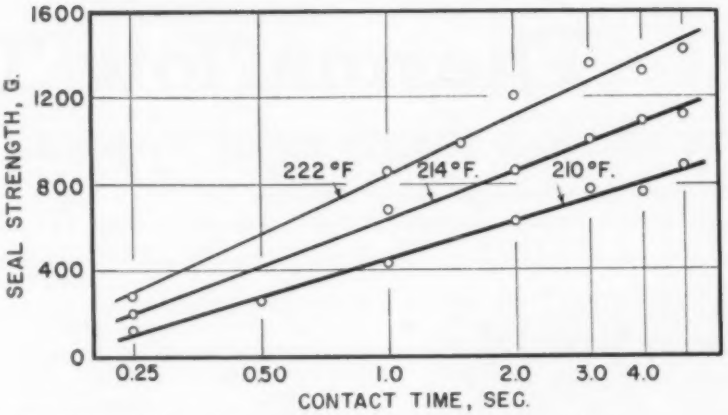
"Where to use urethane foams," by ***T. P. Dougan,*** *Mat'ls in Design Eng. 49,* 86 (Jan. 1959).

Article describes several typical applications for rigid, semi-rigid, and flexible foams. Also included is a chart of properties and a nomograph for estimating the cost if thickness, area, volume, density, and price are known.

General Processing

"Sealability of polyethylene films," by ***J. M. McKelvey*** and ***T. H. Strome,*** MPI *36,* 107 (June 1959).

A basic approach to the problem of heat sealing polyethylene films. This article is a report of investigations which have been made into the nature of the heat sealing process. The results show the various factors affecting the sealing operation such as sealing pressure, platen temperature, contact time, storage conditions, and pretreatments of sealing surfaces.



SEAL STRENGTH of polyethylene film at 10 p.s.i. rises linearly with the logarithm of contact time, and increases very sharply with the platen temperature. ("Sealability of polyethylene films")

A symposium on non-Newtonian fluids in science and engineering, *Ind. Eng. Chem. 51,* 839-888 (July 1959) is worth the attention of every serious student of polymer processing. It includes 17 papers on flow, heat-transfer, agitation, and rheology of non-Newtonian liquids by many authors, including some of the leading researchers in the field. Of especial interest to plastics processors are three on screw extrusion and injection molding, abstracted under those headings elsewhere in this review.

"Molding and forming the new polyolefins" by ***R. D. Hanna*** and ***J. Y. Lomox,*** MPI *36,* 111, (Feb. 1959).

Experience to date with the molding and forming of polypropylene is summarized and compared with high-density polyethylene. Enthalpies, specific volumes, and shear-rate/shear-stress data are presented for most of the processing temperature range; their relationship to processing is discussed. Graphs of required heating time for sheets vs. heater temperature and sheet thickness show that fast heating is safely achieved by radiation with high-watt-density heaters. Suggestions are made for sound mold design and for minimizing warping and shrinkage of molded and formed pieces.

"Polypropylene," by ***G. Crespi*** and ***F. Ranalli,*** *The Plastics Inst. Trans. 27,* 55 (April 1959).

One of the most complete articles to be found on this new material and a "must" reference for people using polypropylene. Numerous graphs relate physical property and processing variables connected with the handling of polypropylene.

"Machinability of polypropylene film," by ***R. M. Winters,*** *Modern Pkg. 33,* 187, (Nov. 1959).

Studies indicate that this new thermoplastic film will perform well on wrapping machines. A list of the machines which have been checked out with the new film is given.

"The concretion of thermoplastic materials; its applications," by ***T. Engel,*** *Ind. des Plastiques Modernes 11,* 38 (July-Aug. 1959). In French.

Article describes a method for making polyethylene articles by a sintering process using powdered resin.

"Automatic film feeding," by ***D. R. Forry,*** *Modern Pkg. 32,* 206 (April 1959).

Problems encountered in feeding limp plastic films to packaging machines have led to research

at Battelle Memorial Institute that shows it is possible to control such film at high web speeds. Methods for accomplishing this are detailed.

"Pin-point important process variables with polyvariable experimentation," by ***F. E. Satterthwaite*** and ***D. Shainin***, *SPE J. 15*, 225, (March 1959).

Random balance, a simple nonmathematical statistical method for the determination of the significant variables in a multi-variable experiment is described. There is some controversy among statisticians as to the validity of this system, which will remain unresolved pending availability of more experimental data. More will be found on the method in **"Roll-chilled PE film,"** by ***J. A. Doti, G. E. Tolle***, and ***C. S. Imig***, MPI 37, 109 (Dec. 1959).

"A meter for film clarity," by ***P. M. Hay, C. P. Evans, K. W. Winneman***, *Mod. Packaging 33*, 179 (Nov. 1959).

Specially developed instrument measures the clarity of transparent and translucent plastic films. The device was designed to reproduce what a viewer sees when observing a wrapped package. In order to observe what is inside the wrapper light rays must just enter the package, be reflected from the object inside and return through the overwrap to the viewer. The meter is built to simulate these conditions.

"Vinyl chloride polymers: their design and application," ***B. S. Dyer***, *The Plastics Inst. Trans. 27*, 84. (June 1959).

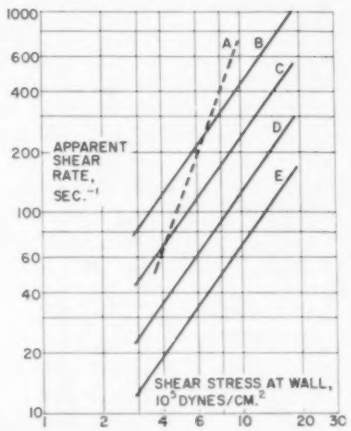
A good review article in simple terms covering a complex technology. Beginning with the monomer, the basic properties of vinyl resins are discussed and how they affect processing and application.

"Cure of polyurethane elastomers with peroxides," by ***E. E. Gruber*** and ***O. C. Keplinger***, *Ind. Eng. Chem. 51*, 151 (Feb. 1959).

Isocyanate-cured polyurethanes have deficiencies in dynamic properties. Data are given comparing properties of such resins with peroxide-cured resins, using several organic peroxides. Scorch and storage problems are eliminated, properties (flex life, compression set) improved by peroxide cure.

"Working with polycarbonate resin," by ***E. F. Fieldler, W. F. Christopher*** and ***T. R. Calkins***, MPI *36*, 116 (April 1959).

This authoritative treatment on processing this new resin begins with a general description of the processing characteristics. It continues with information on injection molding conditions and



FLOW CHARACTERISTICS of polycarbonate and polystyrene resins are: **A:** polystyrene at 440° F.; **B, C, D, E,** PC resin at 650, 600, 550, and 500° F., respectively. ("Working with polycarbonate resin")

equipment design. Extrusion comes next, with recommendation on temperature, die design, etc. Finally, drilling, milling, routing, filing, sanding, bonding, and sealing are described.

"Molding of resilient urethane foams," by ***W. J. Toukey*** and ***R. E. Knox***, *Rubber World, 140*, 711 (Aug. 1959).

Article discusses the variables involved in mixing and delivery, mold filling, and curing of prepolymer type foams in making molded articles, such as cored foam structures. Process is basically simple and will probably find wide use.

"Vinyl foam," by ***C. S. Yoran*** and ***R. J. Stockman***, *Rubber World 139*, 542 (Jan. 1959).

Compounding, processing, and manufacture of vinyl foam made from plastisols by first dissolving the expanding gas in the liquid under pressure and then allowing it to expand is reviewed. Data are also presented on the effect of plasticizer concentration on the load deflection as well as other mechanical properties of such foams.

"Designing rigid urethane foams for low moisture permeability," by ***C. M. Barringer***, *SPE J. 15*, 961 (Nov. 1959).

Rigid foams with a low permeability to moisture can be prepared by controlling resin design, foam formulation, and mixing techniques. Most important are those techniques which produce the highest possible number of small closed cells in the foam. A cell structure of this type is important to the use of the foams as thermal insulating materials for designing and making refrigeration equipment.

"Electroplating of plastic moldings," by ***R. Ulbigan***, Kunststoffe *49*, 45 (Jan. 1959). In German.

Describes details of a process used for electroplating conductive phenolic moldings.

"Triethylenediamine — a new catalyst for making polyurethane foams," by ***A. Farkas, G. A. Mills, W. E. Erner***, and ***J. B. Maerker***, *Ind. Eng. Chemistry 51*, 1299 (Oct. 1959).

This new diamine is a good catalyst for one-step (no prepolymer stage) polyether-polyurethane foams. Only small amounts are required to give foams of good texture and structure. For example, one can make flexible foams with densities under 2.5 lb./cu. ft. that have tensile strengths of 17 p.s.i. and good compression set.

"Pneumatic conveyor pays rent of new plastic extruding plant," *Chem. Proc. 22*, 136 (Nov. 1959).

Article describes the operations of a bulk handling system for polyethylene resin at Chippewa Plastics' new film plant. Resin is received in hopper cars, pneumatically conveyed and stored in silos. Savings have been

reported to be large enough to pay the rent on the entire new factory building.

Sheet forming

"The vacuum forming of high density polyethylene," by ***D. Burgess***, *Brit. Plastics 32*, 195 (May 1959).

Handling of high-density polyethylene has been found fairly critical in vacuum forming processes; however successful results can be obtained. Generally, in forming high-density PE, high-voltage heaters with accurately controlled heating cycles are needed. High vacuums, good mold surfaces, with assisted cooling and mold temperature control, are also necessary.

"New molding process permits three dimensional grille," *Ind. Design 6*, 68, (Jan. 1959).

By using a non-porous cellulose acetate overlay during vacuum forming, porous Dynel fabric is vacuum formed to make Hi-Fi speaker grilles. After the forming is completed the acetate sheet is separated from the formed fabric and discarded. Opens up interesting new possibilities in vacuum forming.

"Thermoforming biaxially oriented film and sheet," by ***J. L. Murphy***, *Plastics Tech. 5*, 42 (Oct. 1959).

A brief survey article describing the chief factors to be considered in a vacuum-forming oriented sheet and film. Among these are: sheet clamping, heat equalization, mold temperature, cycle timing, speed of drape, and degree of vacuum. Also discussed are the effect of stresses in the oriented sheet and the forming equipment.

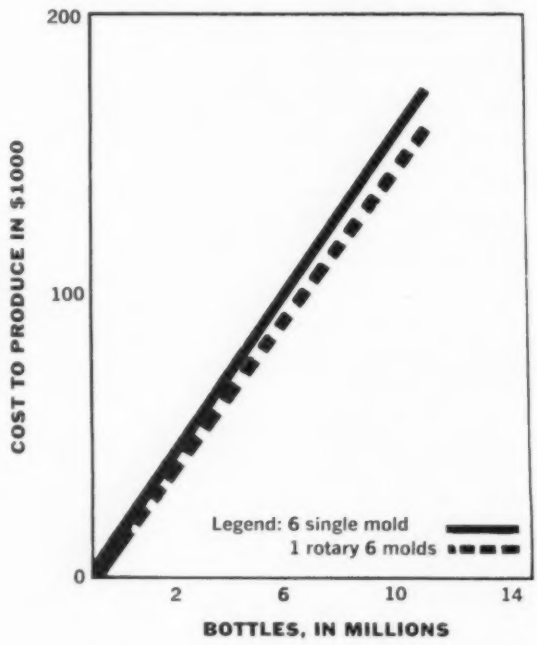
Blow molding

Little was published in 1959 on factors important in blow molding. This is surprising in view of the variety of machines which were offered for sale this year and the large number of applications mentioned in the literature. But little was revealed on how to use the machines and how good blown products can be made. Two articles on process technology stood out and are reviewed below.

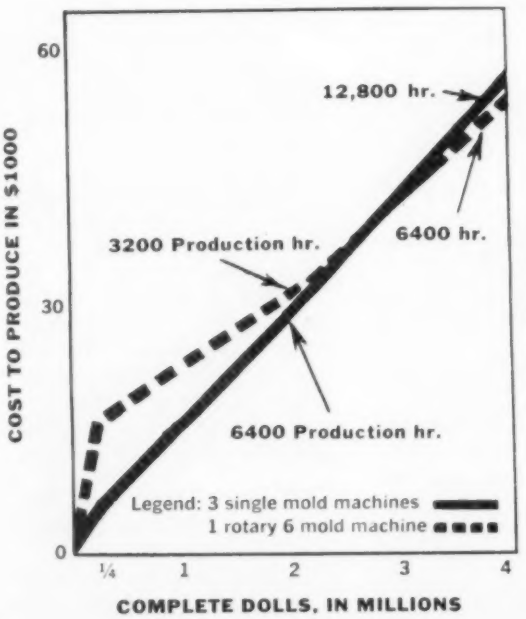
"Blow-molding—economies and markets," by ***Vernon Hill***, MPl *36*, 88 (July 1959).

An authoritative article on the six methods of blow molding: injection with transfer; extrusion with hand transfer; fixed mold with interrupted extrusion; using mold with continuous extrusion; multi-station rotary extrusion; and alternate flow manifold extrusion. Advantages and disadvantages of each process are given. Sample economics and a discussion of most probable markets are presented.

"Blow molding polyethylene, Parts I and II," by ***R. L. Wechsler***



COMPARING the economics of two blow molding systems in making bottles—6 rising mold, single-cavity machines vs. rotary 6-mold.



COMPARING economics of two blow molding systems in making dolls—3 rising-mold, single-cavity machines vs. 1 rotary 6-cavity unit.

and ***T. H. Bayles***, MPl *36*, 107 (May) and 115 (June 1959).

Part I discussed the effects of material and processing conditions on wall thickness and permeability of blown PE bottles and cycle times. Second part of the article discusses the effects of these conditions on appearance, seal welds, uniformity of the thickness and shrinkage. Influence of part design is also considered. Generally, a compromise between cycle time and appearance is necessary.

Compression molding

"Compression of phenolic and polyester premix materials," by ***J. J. Calao*** and ***M. M. Gurvitch***, *Plastics Tech. 5*, 36 (Mar. 1959), discusses the differences between the resins used, the premixes, molding techniques, and formulations. Also included is an economic comparison between the two materials with a sample estimate of the unit cost for a housing. Results show that costs of the finished parts are comparable, the phenolic being a few pennies cheaper.

"Mold heating by steam or electricity," by ***Harold J. Cook*** and ***Howard C. Luke***, *Plastics World 17*, 22 (Sept. 1959).

An analysis of the factors involved in both methods and a study of their comparative operational costs.

"What a plastics engineer should look for when planning to buy a compression or transfer press," by ***F. J. Donahue***, *Plastics Tech. 5*, 53 (Feb. 1959).

An excellent summary reference article on what presses are available and what factors should be considered in the selection of the machine. Included are comparative data on machines available today.

"Faster cure through hotter electronic preheat," by ***A. J. Guyzetti*** and ***R. L. Wechsler***, *SPE J. 15*, 293 (April 1959).

Use of higher preform temperatures, fast and uniform preheating, fast transfer of the charge, coupled with the use of fast acting machines can result in much faster processing than that presently being obtained. Cycle reductions of over 50% have been reportedly been achieved.

"Molding of diallyl phthalate compounds," by ***L. B. Keller***, ***W. R. McGlone***, and ***D. H. Woodin***, *Plastics Tech. 5*, 38 (May 1959).

A discussion of DAP material characteristics, molding, and trouble shooting. Shrinkage, flow, cure, filler, and other variables are covered, as is also the extent to which they affect the molding of these compounds. A good primer on these newer compression molding materials.

"Determination of shrinkage, post shrinkage and swelling of moulding powders," by ***W. Woebcken***, *Kunststoffe 49*, 373 (Aug. 1959).

A comprehensive investigation of shrinkage in thermosetting plastics. Included in the article are plans for an instrument, specially designed for the experiments described, which measures shrinkage on test pieces.

Reinforced molding

Reinforced molders have long been showered with confusing information on the role of glass finishes in reinforced molding, a subject which has approached witchcraft in its obscurity. Prof. McGarry's work (**"Resin-glass bond characteristics,"** by ***F. J. McGarry***, *ASTM Bull.* No. 235, p. 63-8, Jan. 1959) indicates that such finishes do *not* improve bond strength between resin and glass. Rather, their effectiveness is probably due to their aid to the wetting process. Techniques are described for measuring the strengths of bonds between resin and single glass fibers (0.01 to 0.15 in. in diameter). Other conclusions: 1) over the above diameter range, joint strength seems to be unaffected by diameter; 2) polyester-glass bonds are much weaker than either constituent whereas epoxy-glass bonds approach resin and glass strengths.

"Effects of molding variables on reinforced plastic products," by ***T. H. Beals***, ***T. G. Tarr***, and ***C. B. Sias***, *Plastics Tech. 5*, 45 (Oct. 1959).

A thorough study of the effects of processing conditions on the final properties of the cured product. Recommendations for optimum properties are to use a 50 to 60% maleic resin containing 25 to 30% styrene, and to mold this resin in carefully designed tooling of high quality at temperatures between 240 to 260° F.

"Finished surface for boats imparted directly by molds," *West. Plastics 6*, 13 (Aug. 1959).

The need for buffing and polishing reinforced plastics boats was removed by paying especial care to the preparation of the mold surfaces. The process for making the high polish molds is described.

"Refractive index method for determining cure rates of epoxy resins," by ***H. Dannenberg***, *SPE J. 15*, 875 (Oct. 1959).

A new method for listing the cure performance of epoxy resins and curing agents is presented. Results are described in the form of rate *curves*. The effect of curing agent concentrations, influence of aqueous, aliphatic, and aromatic hydroxyl groups on the cure rate, and the temperature dependence of the reaction are also reported. Article contains detailed directions on the procedure and equipment required.

"An easy way to control cure of polyester resins," by ***J. M. Smith*** and ***R. B. Bennett***, *SPE J. 15*, 867 (Oct. 1959).

The method is based on the use of two types of graphs, with detailed steps given on how to obtain data for the construction of these graphs. More important: These steps may be used to obtain similar information for controlling cure of other resins.

"Problems with premix molding," by ***R. B. White*** and ***R. S. Jackson***, MPl *36*, **(To page 146)**

New Genetron® blowing agents slash costs of rigid urethane foams!

...offer many important advantages in urethanes and other foamed plastics!

Here's good news for everyone interested in urethanes and other foamed plastics! By using "Genetron" halogenated hydrocarbon gases instead of carbon dioxide as the blowing agent in urethanes, you can now slash raw material costs, and produce foams with as much as *double* the insulation value! "Genetron" blowing agents give you many "working" advantages, too. Consider all these important benefits:

Far lower "k" factor!

New urethane foams blown with "Genetron" have a lower "k" factor (thermal conductivity) which makes them vastly superior in insulation applications. For example, the "k" factor of a "Genetron" blown urethane foam is in the range of 0.11-0.13 as compared to 0.21-0.25 for urethane blown with carbon dioxide. Result: only ½ thicknesses of "Genetron" blown foam are needed to provide equal insulating value.

Many other important properties, including:

- Low boiling points
- Favorable heats of vaporization
- Non-toxicity
- Non-flammability
- Compatibility with urethane and other plastic raw materials
- Inertness towards the finished product

Better foam control

"Genetron" does not react chemically with other foam constituents. The foaming action is therefore easier to control, since it is a function of the polymerization temperature only.

Shorter cure time

"Genetron" blown foam will cure overnight at room temperature, whereas foam blown with carbon dioxide requires approximately a week under the same conditions.

Reduced isocyanate vapors

Vaporization of "Genetron" reduces some of the heat evolved during polymerization and results in a foaming mass with somewhat lower temperature than when carbon dioxide is used. This lower temperature reduces the amount of isocyanate vapors given off.

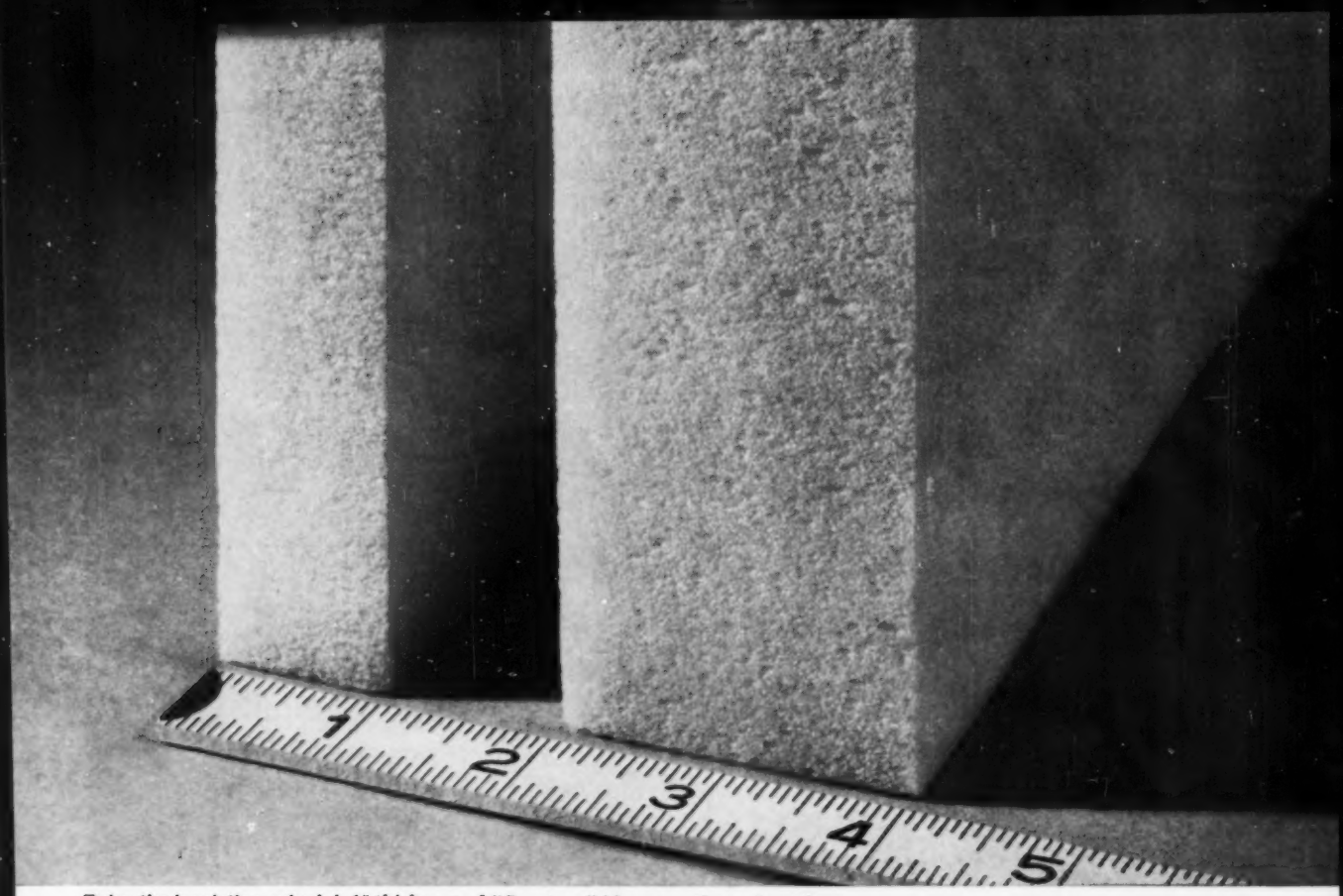
Larger molded forms

The lower temperature of "Genetron" blown foams during rising and curing makes it possible to prepare larger molded forms without risking "burnout" or even more serious charring of the inner portions of the foamed product.

Increased efficiency

With the use of "Genetron" blowing agents in urethane foams, all of the isocyanate is utilized for the polymerization reaction and not to produce the blowing agent.

As a leading producer of halogenated hydrocarbons, General Chemical has helped to develop the use of "Genetron" 11 and other "Genetron" blow-



Twice the insulation value! A 1" thickness of "Genetron" blown urethane foam has the same insulation value as a 2" thickness of foam blown with carbon dioxide!

ing agents as more efficient and less expensive means of blowing rigid urethane foams and other foamed plastics. For example, "Genetron" 113 may be used with "Genetron" 11 to yield mixtures having a boiling point range between 74.7° and 117.7°F.

"k" Factors of Leading Foamed Plastic Materials

(k = Btu/hr./ft.²/°F./in.)

MATERIAL	DENSITY, LB./FT.³	"k"
Urethane, Genetron blown	2.5	0.11-0.13
Urethane, blown by carbon dioxide	4.0	0.21
Urea-formaldehyde, block-form	0.8-1.2	0.18-0.21
Butadiene-styrene	4.5	0.21
Polystyrene	2.0	0.22
Polystyrene	6.0	0.24
Phenolic	2.0-5.0	0.24-0.28
Butadiene-acrylonitrile	10.0-25.0	0.25-0.30
Neoprene	10.0-30.0	0.25-0.35
Epoxy	4.0-20.0	0.264-0.288
Silicone	12.0-16.0	0.30
Cellulose acetate	6.0-8.0	0.31
Polyvinyl chloride	12.0-26.0	0.36

For further information on selected properties of "Genetron" 11 and 113 as blowing agents, just write or phone. Ask for our comprehensive technical bulletins, *"Genetron Blowing Agents for Rigid Urethane Foam"* and *"Determining Genetron Content of Rigid Urethane Foam."*

General Chemical's Technical Service is available to assist customers with "Genetron" applications in the foam field.

Other major components of the urethane foam system are also produced by Divisions of Allied Chemical. Namely, Nacconate® diisocyanates by National Aniline Division; resins by Plastics and Coal Chemicals Division.

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

117 (March 1959); Part 2, *36*, 115; Part 3, *36*, 110; Part 4, *37*, 112.

This four-part series covers virtually every phase of premix molding. First part deals with strength variations in molded parts and voids. Following parts deal with cracking and its elimination; warping, insert molding, thin-wall molding, filling the mold; finishing, small part problems, and mold maintenance. The series serves as an excellent primer for molders now molding or planning to mold any of the premix compounds.

"Mold design for premix," by ***H. J. Duprez***, *Plastics Tech. 5*, 33 (Oct. 1959).

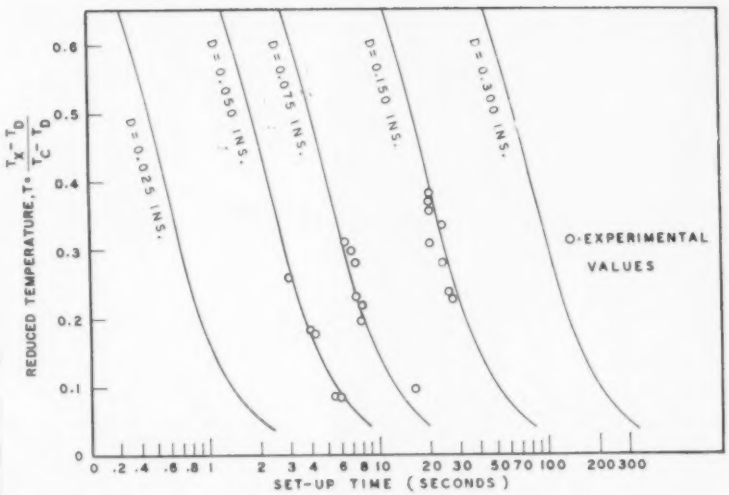
A discussion of the materials and designs for molds for use in molding premix compounds. With few exceptions production molds are being designed in better grade steels with a minimum hardness of 30 Rockwell C. Molds should be well finished for better mold release. Several design considerations are covered, such as heating molds, mold seals, ejection mechanisms, cut-off for holes and floating cavities.

"How to measure uniformity and predict molding characteristics of polyester premixes," by ***A. F. Torres*** and ***S. S. Feuer***, MPI, *36*, 137 (April 1959).

Two new test procedures developed in the Physical Measurement Laboratories of the Atlas Powder Co. are presented. One test involves the measurement of gel time and exotherm time as a means of establishing standards of cure for a molding compound. The second test which involves room temperature (73° F.) extrusion characteristics, provides a method for measuring product uniformity. Tests are correlated with molding conditions.

"Premixed polyester molding compounds in Europe," by ***N. A. Cutler***, *Brit. Plastics 32*, (Aug. 1959).

Based on visits to 46 companies, this survey article is presented in two parts. Part I discusses the various formulation and processing techniques used in Europe. Part II covers molding, testing and the commercial development of these materials. Data include fillers used, typical premix formulations, and applications. Although European processors are optimistic about the future, the markets for premixes, in terms of consumption and number of applications are not as large as in the United States.



COMPARISON OF the calculated theoretical set-up time with experimental observed values. Note the close agreement. Curves also show the relationship of set-up time to mold thickness and temperature variables. All data for an infinite slab of PS with uniform thickness. ("Easy way to calculate injection molding set-up time")

Injection molding

"Saturable core reactor temperature controls," by ***G. Northrup***, *SPE J. 15*, 137 (Feb. 1959).

Tests have shown that the use of these temperature controls on an injection machine result in several advantages. Stock temperature variations are cut in half, injection is smoother, power requirements are reduced, and the tendency of parts to stick in the mold is eliminated.

"Easy way to calculate injection molding set-up time," by ***R. L. Ballman*** and ***T. Shusman***, MPI *37*, 126 (Nov. 1959).

Full-page nomograph in this article allows the molder to estimate set-up time rapidly and with good accuracy from data commonly available from material suppliers. By knowing the proposed operating cylinder and die temperatures; the heat distortion temperature, thermal conductivity, density, and specific heat of the polymer; and the thickest dimension of the part to be molded, the minimum set-up time (for minimum distortion of the molded part on ejection) can either be calculated from the formula given or picked off the nomograph. Based on fundamental, theoretical considerations, this method takes the guess work out of estimating cycle time.

"Comparison between ram and screw cylinders in injection molding machines," by ***H. Goller***, *Kunststoffe 49*, 531 (Oct. 1959). In German.

Screw type machines show a vast superiority over the ram type; however, it is expected both will continue to be used because of existing machinery and because the ram type is the only one suitable for a number of applications. In addition to providing better quality melt the screw machine also lends itself more easily to mathematical analysis which can result in fuller development of technology.

"Get better parts with proper mold filling rates," by ***G. B. Lankton***, *SPE J. 15*, 31 (Jan. 1959).

Article points out that injection pressure, cylinder temperature, ram speed, and the uniformity of the temperature of the melt can affect the way a mold fills as

Physical Properties of Polyester Laminate

	28.5% Surfex MM	40% Surfex MM	50% Surfex MM	60% Surfex MM
Specific Gravity	1.76	1.80	1.87	1.95
Izod Impact, Ft. Lbs./In. Notch	14.4	16.2	17.3	16.5
Tensile Strength, psi	20,300	21,300	20,100	19,300
% Elongation	1.89	1.92	1.94	1.87
Modulus of Elasticity in Tension, psi x 10⁶	1.15	1.36	1.45	1.85
Flexural Strength, psi	33,150	33,600	37,800	37,000
Modulus of Elasticity in Flexure, psi x 10⁶	1.08	1.18	1.44	1.20
Barcol Hardness (10 sec. Reading)	55	57	62	66
Initial Viscosity of Mix	1,200	2,100	3,200	5,000
Fiber Glass Mat	40%	40%	33%	33%



New data for Polyester Laminates shows costs down, flexural and impact strength up... with Diamond SURFEX MM®

Here's the extender you've been looking for. In addition to improving flexural and impact strength—while still keeping costs low—high loadings of this amazing precipitated calcium carbonate provide *all* the top properties *you* want in *your* laminate.

Increased hardness . . . less shrinkage . . . greater modulus of elasticity in tension and flexure. Better surface finish . . . improved wet strength . . . and a more even cooling rate.

Call your Diamond Representative today. Or write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

Diamond Chemicals

much as the mold design itself. By proper control of these variables, better dimensional tolerances, better control of surface finish, and reduction of molding defects can be obtained.

"What a plastics engineer should look for when planning to buy auxiliary equipment for injection molding," by ***G. B. Thayer,*** *Plastics Tech.* 5, 43 (May 1959).

An excellent reference article by an expert in the field. Discusses the factors to be considered when buying hopper loaders, hopper driers, drying ovens, feeders, voltage regulators, heat controls, extra heating cylinders, nozzles, mold temperature regulators, and scrap grinders. Also included is a comprehensive list of specifications on most of the machines available today as well as a directory.

"Preplasticising in injection molding," by ***E. G. Fisher*** and ***W. A. Maslen,*** *Brit. Plastics 32,* 417 (Sept. 1959).

The requirements leading to the design of preplasticating machines are described and a short history of the development of the technique is given (Part I). Equipment in current use is classified and short descriptions of machines representative of each type are included (Part II). The article is concluded with a critical review (Part III) in which the systems are compared and an attempt made to suggest the requirements of an actual system.

"Thin wall injection molding," by ***J. R. Kent,*** *Plastics World 17,* 10 (Aug. 1959).

A summary of techniques for thin wall molding. A check list of commonly encountered troubles and suggested solutions is included. Brief, but to the point.

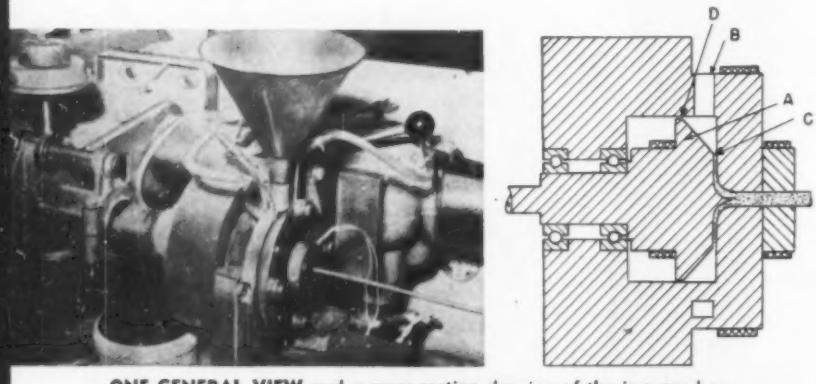
"Insulated runner systems for injection molding," by ***J. N. Scott, D. L Peters,*** and ***P J. Boeke,*** *SPE J. 15,* 785 (Sept. 1959).

A new technique for hot runner molding is described. By making the runners heavier than usual the insulating properties of the plastic being molded are utilized to keep the inner core of the runner hot and molten. Using a ½-in.-diam. runner it was found that the solidified insulating skin of the main runner was 0.1 in. thick and the skin of the sprue was 0.03 in. thick. Thus succeeding shots pass through the adequate ¼-in. molten inner core of the runner without the necessity for external heaters to keep the runners open. Since no external heaters are required, hot runner mold design is simplified and cost is reduced.

A basic problem in injection molding—the filling of a cold cavity with a hot non-Newtonian fluid—is given a rigorous engineering approach in **"Injection molding—a rheological interpretation, Parts I and II,"** by ***R. L. Ballman, T. Shusman,*** and ***H. L. Toor,*** MPl 37, 105 (Sept.) and 37, 115 (Oct. 1959). The mean fluid velocity has been found to decrease exponentially with time as the fluid moves into a cavity of constant cross-section under a constant applied pressure. The velocity falls much more rapidly and the time dependence is considerably different from what would be expected for isothermal flow. These differences are attributed to heat transfer effects in the cavity. Experimental results are presented to support the analysis.

Extrusion

Most exciting development in extrusion reported this year was the elastic melt extruder. This new extruder is a radical departure in design from the conventional extruder in that it has no screw. Developed by Bryce Maxwell and Anthony Scalora at the Princeton Plastics Laboratories, extrusion is accomplished by utilizing the elastic properties of plastic melts to develop a centripetal pumping action which provides the driving force to push the material through the die. In operation this is done by intensively shearing the material between two parallel disks, one of which rotates against the other, which is stationary. Advantages of the new extruder design include the extremely short time it takes the material to pass through the extruder and the excellent dispersions of pigment possible due to the concentrated intensive shearing the material undergoes. Chief immediate uses for the elastic melt extruder will probably be in wire coating and the compounding of materials. A complete discussion of the new machine will be found in **"The elastic melt extruder—works without screw,"** by ***B. Maxwell*** and ***A. J. Scalora,*** MPl 37, 107 (Oct. 1959).



ONE GENERAL VIEW and a cross-section drawing of the improved experimental elastic melt extruder. The photo at the left is an overall view showing the drill press which was adapted to provide a variable speed drive for the rotor. The cross-section drawing at the right shows the shearing zone at **C,** into which falls molding powder through feed tube **B.** ("The elastic melt extruder—works without screw")

"The extrusion of unplasticized PVC film," by ***A. E. Parker, Brit. Plastics 32,*** 456 (Oct. 1959).

Paper describes the processing conditions and equipment used to

extrude blown PVC films. Best unplasticized PVC formulation used a barium-cadmium-epoxide stabilizer system which had excellent extrusion characteristics and produced a film with excellent color, clarity, and light stability. Films can be heat sealed by usual methods. The film is expected to find large markets in glazing, agricultural uses such as mulching and silos, etc.

"Extrusion of polyethylene film with controlled properties," by ***W. A. Haine*** and ***H. B. Robinson***, *SPE J. 15*, 233 (March 1959).

Article describes the effects of compound temperature, film speed, draw distance, and water cooling bath temperature on such properties of the finished film as transparency, tensile strength, and bag drop height.

"Effect of wear on the delivery capacity of extruder screws," by ***B. H. Maddock***, *SPE J. 15*, 433 (May 1959).

Of interest to all extruders is the ability to maximize the output from a given extruder. This article points out how wear on the screw and barrel can reduce the output of an extruder, and recommends that the screw be replaced or repaired when the clearance between the screw and the barrel has increased to about 15% of the channel depth.

"A visual analysis of flow and mixing in extruder screws," by ***B. H. Maddock***, *SPE J. 15*, 383 (May 1959).

Flow paths through the screw channel were easily observed by introducing colored PE and PVC particles into an extruder, stopping the extruders, removing the filled screw and visually inspecting the progress of the colored material down the barrel. Included in the paper are numerous photographs of flow patterns developed by the above technique. It was found that if the channel at the exit end is too deep or if too much lubricant is used there is little mixing action produced in an extruder.

"Liquefaction of thermoplastics—a new melt process for extrusion and pre-plastication," by ***T. Engel***, *Kunststoffe 49*, 406 (Aug. 1959). In German.

Developed independently in Germany, the Engel extruder uses rotating disks similar to the elastic melt extruder described above to preplasticate material prior to transporting it by means of a screw and barrel similar to the conventional machine. Since the material is preplasticated, the screw and barrel are unheated or cooled and the machine requires considerably less driving power.

"Improvement of screw extruder efficiency by increasing peripheral speed," by **E. Beck**, *Kunststoffe, 49*, 315 (July 1959).

Several advantages can be gained by increasing screw speed. Among these are increased output, shorter cylinder lengths, elimination of reduction gears, and decreased retention time. Included in the article is a comprehensive discussion on effects of running at higher speeds.

"Extrusion theory—Parts I and II," by ***D. M. Hurlburt, S. Katz, L. F. Street***, *Plastics Tech. 4*, 1110 (Dec. 1958); *5*, 39 (Jan. 1959).

A discussion of what actually happens in an extruder. An excellent review for all extruders using screw machines.

"Mathematical bases for designing sheeting and tubular dies," by ***Von L. Kling***, *Kunststoffe, 49*, 463 (Sept. 1959). In German.

Based on a mathematical analysis by D. J. Weeks, this article discusses the pressure build-up and distribution of flow in wide slit and tubular dies such as are used in the extrusion of film and sheet. Although absolute accuracy is not guaranteed, the mathematical expressions can be used to avoid mistakes in practical applications. Article includes details of the development of the mathematical expressions.

"The screw extruder," by ***R. E. Colwell*** and ***K. R. Nickolls***, *Ind. Eng. Chem. 51*, 841-3 (July 1959).

The theory of melt extrusion has been extended by introducing variation, due to non-Newtonianism, across the depth of the screw channel. Effects of temperature variation with depth have also been included in the calculations, which were made with the aid of an IBM 704 computer. Typical operating data are computed for PS melt; they seem to compare well with observed values.

"The application of flexible conduits in extrusion," by ***E. C. Bernhardt*** and ***W. M. Edwards***, *SPE J. 15*, 807 (Sept. 1959).

Plastic melts can be piped from an extruder through a flexible conduit or hose. Construction and operation of the conduits are discussed. Several uses for this process technique are 1) extrusion welding; 2) casting; 3) connecting two extruders to the same die; 4) placing colored decorative patterns on plastic or non-plastic substrates; 5) applying several different resins to the same substrate. PE, nylon, and acrylic resins have been successfully processed.

"Flow, power requirement, and pressure distribution of fluid in a screw extruder," by ***Mohr*** and ***Mallouk***, *Ind. Eng. Chem. 51*, 765-70 (June 1959).

Through a new analysis of the transverse flow component in the screw channel, the authors present new expressions for leakage flow and power consumption in extruders pumping viscous Newtonian liquids. Leakage flow is only about 10% of that predicted by earlier equations, while calculated power consumptions are slightly higher.

"Extruder design for a pseudoplastic fluid," by ***E. S. DeHaven***, *Ind. Eng. Chem. 51*, 813-6 (July 1959).

The author presents equations for output and power in a screw extruder pumping a non-Newtonian melt that obeys the shear-rate—shear-stress equation:

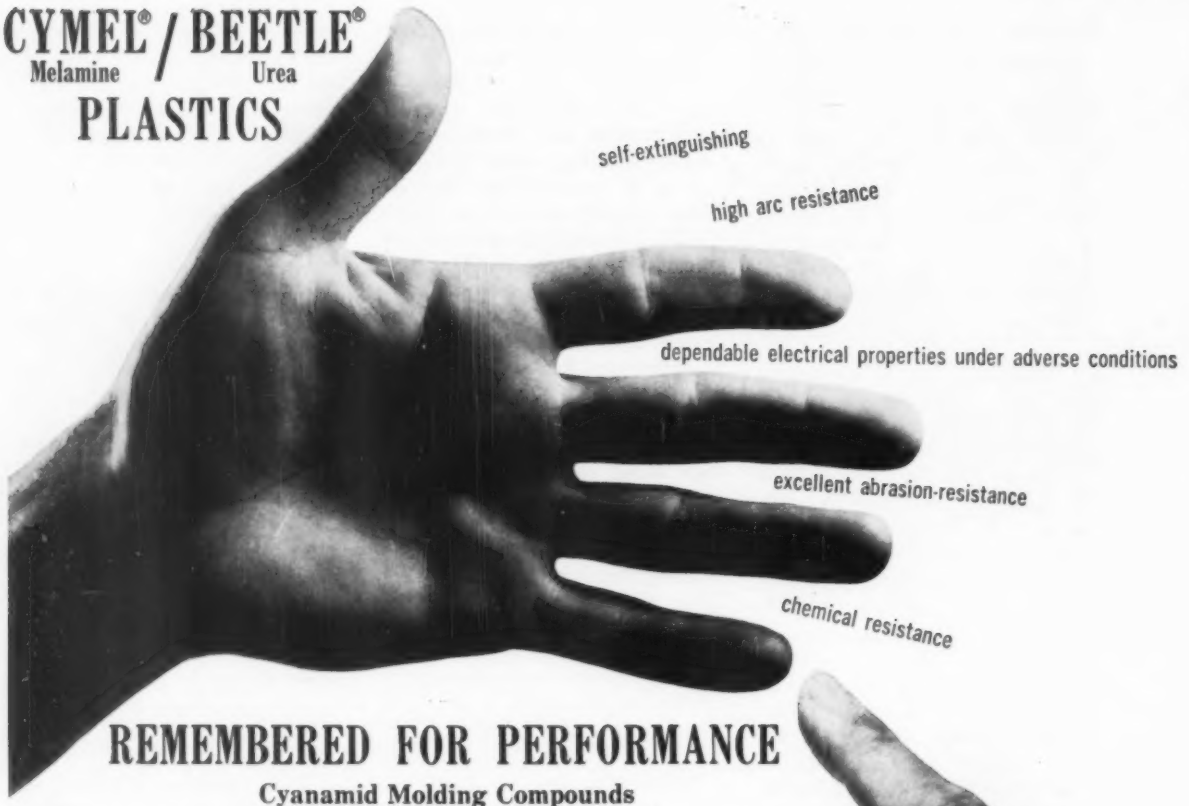
$$-(dv/dy) = \tau(1 + C\tau^2)/\mu_0$$

Results are presented in "reduced-variable" charts to facilitate their use in design of extruders for pseudoplastic melts.

"High density cellular vinyl," by ***R. J. Meyer*** and ***D. Esarove***, *Plastics Tech. 5*, 32 (April 1959).

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PLASTICS* TECHNICAL SECTION

MATERIALS • PROPERTIES • TESTING METHODS AND INSTRUMENTATION • STANDARDS • CHEMISTRY

The year 1959 in review

This year marks the end of another decade of continuing growth by the plastics industry. The record shows that the bright future foreseen at the turn of the decade (1) has been realized.

Production of plastics has increased more than three-fold to reach the 5½-billion-lb. mark. Among the new materials produced during the '50s in the United States are polyurethanes, linear polyethylene, polypropylene, polyformaldehyde, polycarbonates, polyethylene oxide, and chlorinated pentaerythritol, as well as a host of new copolymers of the epoxy, styrene, nylon, vinyl, and polyester types. Especially noteworthy is the discovery during the decade of stereospecific catalysis and its practical application in the production of polymers of improved strength and heat resistance.

Pioneering work in 1953 saw the fast-moving atomic energy developments applied to produce useful changes in the physical properties of long chain polymers, notably the crosslinking of polyethylene to achieve resistance to steam sterilization. The application of ionizing radiation to the production of block and graft copolymers has provided another means of improving the properties of plastics and modifying their characteristics as required for special purposes.

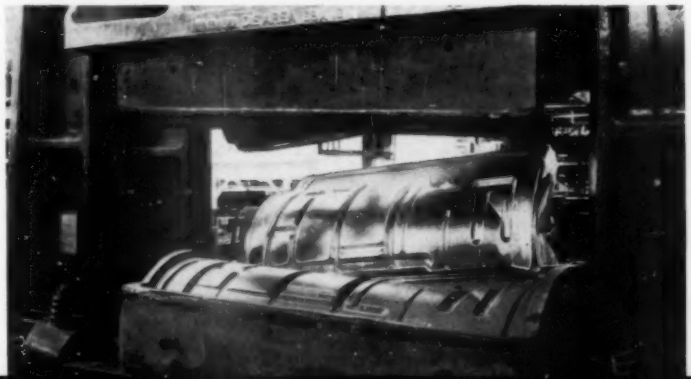
Important advances have been made in semi-structural and structural applications of plastics. The consumption of plastics by the building industry is approaching 1 billion pounds. The chemical industry is taking advantage of the corrosion resistance of plastics in pipes, fittings, ducts, and tanks. The pioneering use of reinforced plastics in the Chevrolet Corvette body has been followed by weight-saving applications in trucks, trailers, and buses. Reinforced plastic boats have become a significant factor in the small craft field. Plastics are competing favorably with ceramics and metals for missile structures that must resist ultra high temperatures for short periods. Further studies are in progress to provide the engineering data required for their use in space vehicles.

Significant progress has been made in the preparation and promulgation of standards for plastic materials and products. A.S.T.M. Committee D-20 on Plastics has approximately doubled the number of standard test methods and specifications for plastics during the decade; the total is now 105 test methods, 49 specifications, and 12 recommended practices and related standards. Technical Committee 61 on Plastics of the International Standardization Organization has prepared 38 Draft Proposals and ISO Recommendations pertaining to plastics since its establishment in 1951. Seventeen Commercial Standards and two Simplified Practice Recommendations covering plastics and resinous adhesives were approved and published by the Department of Commerce during the '50s.

The Future?

It is of interest to pose the same question that was raised in the January 1950 review, updating it by a decade: what will the '60s bring? Forecasts of annual production of plastics by 1970 agree on a minimum figure of 11 billion lb.; this seems reasonable on the basis of growth curves and population increase. The polyolefins, in particular ethylene and propylene types, will be primarily responsible for a large portion of this growth due to both economic factors and property versatility. Improvements in materials will result from new techniques in stereospecific catalysis, graft copolymerization, crosslinking included by irradiation, and control of physical structure as related to crystallization, spherulite size, and

EPOXY-FACED drop-hammer die (foreground) used for forming sheet aluminum aircraft part (rear) shown being removed from press. (Ref. 52, p. 155). Epoxy face has high impact strength, yet can handle most gages of aluminum and thinner steels.



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1. "The year 1949 in review," by G. M. Kline, Modern Plastics 27, 205 (Jan. 1950).

molecular orientation. These developments are particularly applicable to the production of desired properties in hydrocarbon plastics. Progress in automatic preforming and molding of reinforced plastics can be expected to lead to a breakthrough in the application of this type of material in the manufacture of lightweight and noncorrosive housings, building construction units, transportation vehicles, missile parts, and other engineering equipment.

The increasing awareness of the need for quality standards and reliable engineering guidelines will result in the publication of a record number of national technical specifications for plastic materials and products. In order to maintain the prestige and usefulness of these standards and hallmarks, a system of inspection and testing may be established comparable to that employed successfully in Germany for more than 20 years for determination of conformance of molding materials and molded products to the specifications of the German Standards Association. Perhaps this will be one of the functions of a Plastics Institute which can be expected to be organized to serve as a research and documentation center for this dynamic and progressive industry. Finally, the growth of plastics production and consumption in other countries and the impact of international standards for plastics in this foreign trade will make us more conscious of the metric system of measurement and set the stage for the eventual transition from the yard-pound to the meter-kilogram system, a transition which Japan and India are completing in their industries.

Radiation and grafting

The tremendous potential of irradiation, particularly nuclear radiation, in modifying the properties of polymers and in producing new materials by initiating graft and block copolymerization was reflected in the large number of publications in 1959 relating to technological problems and products obtained by irradiation techniques. The different types of radiation, the various means of producing them, and the advantages and disadvantages of radiation polymerization, including cost considerations, were reviewed (2, 3). Gamma-radiation effects on polyethylene (4-6), acrylic plastics (7, 8), styrene copolymers (9), siloxanes (10), polyesters (11), elastomers (12), plastic films (13), and electrical insulation (14) were investigated. Other reports described protective agents against radiation (15), and use of transparent plastics for radiation dosimetry (16).

The principles of graft and block polymerization and the types of polymers produced were dealt with by various authors (17-19). Specific graft copolymers studied included caprolactam on acrylic (20) and vinyl (21) polymers, vinyl acetate-vinyl alcohol (22), styrene on polyethylene (23), polyesters (24), and rubber (25), methylacrylate-acroyl chloride (26), isobutene-chloromethylstyrene (27), acrylics on rubber (28), and vinyl monomers on polyalpha-olefins (29).

Materials

Acrylics: Promising developments in the use of acrylic resins in industrial protective coatings (30) and floor polishes (31) were reported. The photoelastic (32, 33) and mechanical properties (34) of methacrylate polymers were explored. A new process has been perfected for the production of acrylonitrile monomer from acetaldehyde (35).

Cellulosics: Noteworthy reports were published on the properties of cellulose propionate (36), acetate (37), acetate butyrate (38), and nitrate (39), and nitrocarboymethyl cellulose (40). Production statistics for cellophane showed that output remained at approximately 400 million lb. during the period 1956-58 with 75% of the film going into food packaging (41). Cellulosic hot melt

2. "Polymerization with radiation. Part I. General considerations," by R. F. Boyer, SPE J. *14*, 47 (Sept.); "Part II. Technological considerations," by R. McFedries, SPE J. *14*, 33 (Oct. 1958).
3. "Impact of atomic energy upon the rubber and plastics industry," by R. Roberts, Plastics Institute Trans. & Journal *27*, 1 (Feb. 1959).
4. "Dynamic mechanical properties of irradiated polyethylene," by E. Butta and A. Charlesby, J. Poly. Sci. *33*, 119 (Dec. 1958).
5. "High-temperature mechanical properties of unfilled and carbon-black-loaded irradiated polythene," by S. H. Pinner, Plastics *24*, 74 (Feb. 1959).
6. "Dynamical properties of the new "rubberlike" irradiated polyethylene," by A. A. Rady, J. Appl. Poly. Sci. *1*, 129 (Mar.-Apr. 1959).
7. "High-energy radiation effects on polyacrylates and polymethyl methacrylates," by Shults, Journal Poly. Sci. *35*, 369 (Mar. 1959).
8. "γ-Irradiation of polymers of aryl and alkaryl methacrylates and acrylates," by R. K. Graham, J. Poly. Sci. *37*, 441 (June 1959); *38*, 209 (July 1959).
9. "γ-Irradiation of styrene copolymers," by W. Burlant, D. Green, and C. Taylor, J. Appl. Poly. Sci. *1*, 296 (May-June 1959).
10. "Swelling and elasticity of irradiated polydimethylsiloxanes," by L. E. St. Pierre, H. A. Dewhurst, and A. M. Bueche, J. Poly. Sci. *36*, 105 (Apr. 1959).
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12. "Effects of gamma radiation on nitrile elastomers," by R. Harrington, Rubber Age *85*, 963 (Sept. 1959).
13. "Effect of radiation on plastic films," by C. F. Bersch, R. R. Stromberg, and B. G. Achhammer, Mod Pack. *32*, 117 (Aug. 1959).
14. "Radiation effects on insulation, wire, and cable," by C. J. Lyons and R. I. Leininger, Insulation *5*, 19 (May 1959).
15. "Protection provided by added substances against the direction action of ionizing radiations," by P. Alexander and D. J. Toms, Radiation Res. *9*, 509 (Nov. 1958).
16. "Radiation dosimetry by transparent plastics," by Boag, Dolphin, and Rotblat, Radiation Res. *9*, 589 (Dec. 1, 1958).
17. "Graft and block polymerization," by C. G. Overberger, Chem. Eng. News *36*, 80 (Nov. 10, 1958).
18. "On certain trends in the synthesis and practical application of graft copolymers," by A. A. Berlin, J. Poly. Sci. *34*, 371 (Jan. 1959).
19. "Graft copolymerization by pre-irradiation technique," by D. Ballantine, A. Glines, G. Adler, and D. J. Metz, J. Poly. Sci. *34*, 419 (Jan. 1959).
20. "Grafting of polycaprolactam on a polymethacrylate-type backbone," by Wichterle and Gregor, J. Poly. Sci. *34*, 309 (Jan. 1959).
21. "Preparation and properties of grafts of polycaprolactam on vinyl polymers," by C. B. Chapman and L. Valentine, J. Poly. Sci. *34*, 319 (Jan. 1959).
22. "Graft copolymer formation during the polymerization of vinyl acetate in the presence of polyvinyl alcohol," by F. D. Hartley, J. Poly. Sci. *34*, 397 (Jan. 1959).
23. "Irradiation grafting of styrene to high pressure and low pressure polyethylene films," by A. S. Hoffman, E. R. Gilliland, E. W. Merrill, and W. H. Stockmayer, J. Poly. Sci. *34*, 461 (Jan. 1959).
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28. "Graft copolymers from natural rubber latex using visible, ultra-violet, and gamma-ray initiation," by Cooper, Vaughan, Miller, and Fielden, J. Poly. Sci. *34*, 651 (Jan. '59.)
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30. "Acrylics ply industrial paint market," Chem. Eng. *14*, 96 (July 13, 1959).
31. "Chemicals team up to make a better polish," Chem. Eng. *66*, 76 (Fe- 9, 1959).
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39. "Investigation of heat stabilizers for nitrocellulose film," by G. P. Sollott and F. Einberg, J. Chem. Eng. Data *4*, 266 (July 1959).
40. "Nitrocarboxymethyl cellulose," by H. C. Haas and N. W. Schuler, J. Poly. Sci. *36*, 447 (Apr. 1959).
41. "Cellophane meets competition," Chem. Eng. News *37*, 28 (Jan. 19, 1959).



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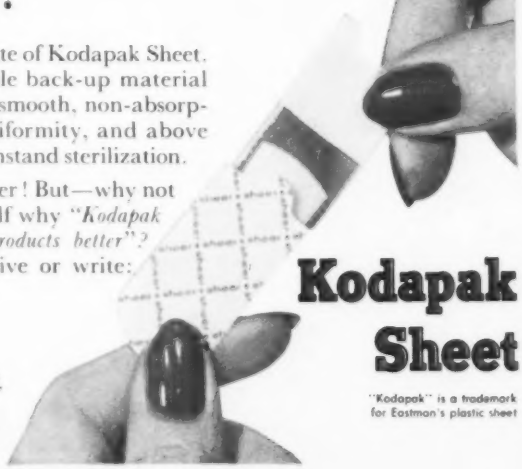
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Epoxies: The favorable electrical properties, good dimensional stability, and low moisture absorption of epoxy-resins are important factors in the continued research and development programs directed toward production of new raw materials (43-46) and new combinations of epoxidized resins and fillers (47, 48). A growth from the present 40 million lb. output to over 100 million lb. annually is foreseen to provide epoxy resins for such applications as protective coatings (49, 50), adhesives (51), tooling (52), electrical insulation (53, 54), foams (55, 56), building panels and seals (57), flooring (58), reinforced pipe (59), and plasticizers (60). Important contributions were made to our knowledge of the strength properties (61, 62) and electrical characteristics (63, 64) of epoxy plastics.

Fluorocarbons: Semi - works production of polyvinyl fluoride film was announced in 1959; this flexible film in the lower price range combines weatherability, chemical inertness, and toughness. Its potential applications include packaging of greasy and corrosive materials, electrical insulation, flexible glazing, and protective surfacing of wood, aluminum, and galvanized steel, as well as fabrics (65, 66).

Properties and processing of the new copolymers of tetrafluoroethylene and hexafluoropropene were described (67-69). Surface properties of fluorocarbons can be modified by graft polymerization (70). The low frictional characteristics (71, 72) and chemical resistance of polytetrafluoroethylene are important factors in its many applications in bearings (73) and gaskets (74). The stability of fluorocarbons in the presence of amines (75) and high-pressure oxygen (76) was investigated. Chemforming provides an improved method for producing thin-walled moldings of polytetrafluoroethylene with minimum scrap loss (77). Fluorocarbons remain outstanding among polymers in the search for elastomers resistant to high temperatures (78).

Olefins: Polyethylene and polypropylene are having the fastest rate of growth of any of the plastics materials. Polyethylene has passed the vinyl plastics as the leader in output and will exceed 1 billion lb. in 1959. Several plants for the production of polypropylene are under construction at the present time and it is predicted that this material will approach the billion-pound figure by the year 1965.

The literature has reflected this tremendous interest and development push in the polyolefin field. Many articles have appeared reviewing advances in the preparation, processing, and applications of polypropylene (79-82) and polyethylene (83-88). Copolymers of ethylene-propylene (89) and ethylene-butene (90) are being produced to obtain unique properties and superior performance. Improved techniques for blow molding (91), vacuum forming (92), extruding (93-95), and injection molding (96, 97) polyethylene were described. A new casting process for production of polyethylene film by flat-film extrusion onto chilled rolls yields a product with optical properties equaling those of cellophane, and stiffness, slip, and thickness uniformity required in automatic packaging equipment

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43. "Progress in high temperature resins: epoxy novolaks," by D. D. Appelgath, R. F. Helmreich, and G. A. Sweeney, SPE J. *15*, 38 (Jan. 1959).
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50. "Solventless coating," by H. W. Howard, Modern Plastics *36*, 85 (July 1959).
51. "Tops in industrial adhesives," by B. Gould, Modern Plastics *37*, 110 (Nov. 1959).
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GENERAL VIEW of post-extrusion processing equipment, showing roll of oriented styrene overlay film (left) which is laminated to appearance side of extruder sheet stock to produce a high gloss. (Ref. 179).

(98, 99). Various treatments of polyethylene film to improve sealability (100, 101), slip (102), and permeability to air (103) were described. Fast-growing markets for polyethylene exist in large (up to 500 gal.) chemical containers (104), garden tools (105), agricultural uses (106), packaging (107), wire and cable coverings (108), pipe (109, 110), housewares (111), and protective coatings (112).

The problems of environmental (113-115) and thermal (116) stress-cracking of polyethylene were studied and new thermal antioxidants developed (117, 118). Other properties reported on included creep-rupture behavior (119-122), low temperature brittleness (123), stiffness modulus (124), impact strength (125, 126), gas permeability (127-129), corona resistance (130), dimensional changes (131), and sound conductivity (132). One research report contained photomicrographs of large particles of polyethylene thought to be actual molecules of 40,000,000 molecular weight (133). Tests for aluminum and titanium (134) and carbon black dispersion (135) in polyethylene were published.

Phenolics: Advances in resin formulation, fillers, and processing automation are serving to keep the phenolics in the 500-million-lb. production range in the 50th anniversary year of their discovery (136). Among the specialty compositions are furfurylated resins (137, 138), phenolic-rubber mixtures (139, 140), nylon (141) and glass (142) filled molding compounds, and foam products (143). Factors affecting tensile strength in phenolic moldings (144), adhesion of coatings to phenolic surfaces (145), cure (146), and chemical resistance of laminates (147) were discussed in considerable detail.

Polyamides: The nylon plastics are finding applications in engineering equipment where their wear resistance and toughness are advantages (148-151). Copolymerization of 6 and 66 nylon salts with piperazine to improve flexibility for wire and cable covering was investigated (152). Continuous polymerization of caprolactam in a vertical unit with four distinct reaction temperature zones is reported to yield nylon-6 molding and extrusion resins of greatly improved uniformity in processing

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characteristics (153). Research on properties of polyamides included studies of mechanical (154, 155) and electrical (156) properties and thermal stability (157).

Polyesters: Unsaturated polyester - styrene resins prepared with isophthalic acid provide improved strength and curing characteristics in castings and laminates (158, 159). New modifications in self - extinguishing compositions are based on the use of organic phosphonates and incorporation of titanium or antimony types of organometallic fillers (160). Other developments in polyester technology include formulations containing diallyl monomers (161) and bisphenols (162), and radiation curing (11). Polyester premix molded parts (163), spray-on coatings for concrete blocks (164, 165), and conductive castings (166) are among the new uses described. Studies were made of the thermal (167), weathering (168), and chemical (169) resistance of polyesters and their absorption on glass, silica, and alumina surfaces (170). Applications and properties of polyethylene terephthalate film (171-173) and fiber (174-176) indicate that this material will continue its upward growth pattern.

Styrene polymers and copolymers: An 80/20 copolymer of butadiene-styrene offers advantageous properties for the production of translucent glass-reinforced laminates with good chemical stability (177). ABS copolymers are expanding their markets in pipe and fittings applications (178) and in thermoformed refrigerator door liners and the like (179, 180). Modifications in polystyrene formulation and processing are providing improved performance in lighting fixtures (181), packaging film (182-184), and foams for building panels (185), refrigerators (186), and chair frames (187). New data were published pertaining to the properties of polystyrene (188, 189) and styrene derivatives (190, 191).

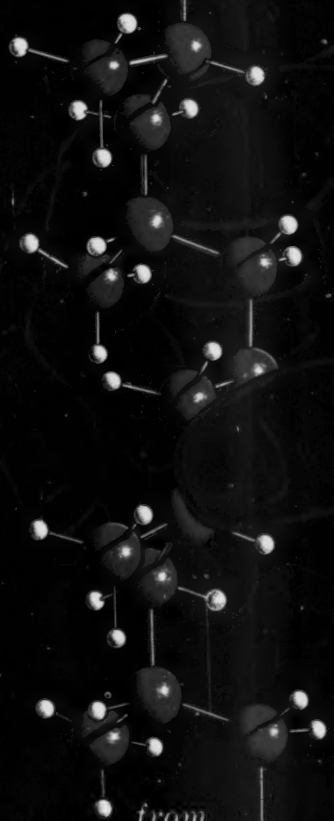
Urethanes: Typical of the newer and vigorously active additions to the family of commercial plastics, the literature on polyurethanes in 1959 is replete with discussions of the latest developments in raw materials, processing techniques, and new applications (192-194). Urethane foams occupy the center of attention, with the flexible type competing for the cushioning market (195, 196) and the rigid type headed for structural panel uses (197-199). It is estimated that production by 1963 will reach 130 million lb. of flexible and 65 million lb. of rigid foam. New raw materials proposed for use in urethane foams (200, 201) include sorbitol polyethers (202) and polyether triols (203). Other major outlets for polyurethanes are developing in protective coatings (204, 205), elastomeric products (206, 207), potting compounds (208 - 210), adhesives (211), and laminating resins (212).

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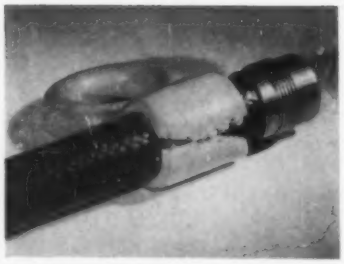
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billion lb. mark in 1959. Polyvinyl chloride and its copolymers dominate in this category (213-218). New plasticizers (219-222), stabilizers (223-225), and fillers (226) for compounding with PVC were described. Outstanding application developments occurred in vinyl pipe (227-231), foam (232-235), vinyl-metal laminates (236-238), solid propellants (239), footwear (240), and wall coverings that are currently being used in hospitals (241).

Information on properties of PVC and its copolymers concerned dielectric behavior (242), flow (243), low temperature cracking (244), and resistance to heat (245), sunlight (246), and fungus (247). Reports of developments in other vinyl plastics pertained to polyvinyl alcohol (248-250), polyvinyl acetate (251), polyvinylidene chloride (252), and vinyl carbazole (253).



ADVANCING FRONTS of glass premix compound just before "welding." (Ref. 298).

Other polymers: The four new resins announced and marketed in the past three years are exploiting their specialized properties in premium-priced applications; these materials are the polycarbonates (254-256), polyformaldehyde (257-263), chlorinated pentaerythritol (264), and polyethylene oxide (265, 266). Silicone resins and rubbers are diversifying both in types and uses (267-270). Developments were reported in furane resins (271), ion exchangers (272, 273), coumarone-indene resins (274), butadiene polymers (275, 276), polysulfides (277), and chlorosulfonated polyethylene (278). New polymers described included polymerized xanthene (279), methyl isopropenyl ketone (280), polybischloromethyl oxetane (281), pentaerythritol biacetals (282), and inorganic polymers based on boron and phosphorus (283). Developments were reported in stereospecific catalysis (284-286), allyl polymerization (287), and interfacial polycondensation (288).

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Reinforced plastics: The approximately 200 million lb. of glass-fiber-reinforced plastics consumed in 1959 went into boats (289), building construction panels (290), automobile and truck bodies and parts (291), aircraft and missile parts (292, 293), pipes and tanks (294, 296), and springs (297). Major advances were made in premix molding (298-301), sprayup techniques (302), automatic preforming and impregnation (303), filament winding (304), and fabrication and finishing of RP products (305-308). The growing importance of reinforced plastics as a new material of construction was indicated by the studies conducted on their properties, including resin-glass bonding characteristics (309, 310), mechanical strength (311-317), heat resistance (318-320), electrical behavior (321, 322), flame resistance (323), light transmittance (324, 325), steam resistance (326), and weathering characteristics (327, 328).

Foamed plastics: Significant developments were reported in the preparation and application of cellular plastics made of urethanes (195-203, 329), styrenes (185-187, 189), phenolics (143), epoxies (55, 56), and vinyls (232-235, 330). Sandwich panels of greater variety in color and design are providing architects with an economic material for partitions and ceilings (331-333). The performance of foamed plastics under impact (334-336) and compression (337) loading conditions was investigated.

Plasticizers, stabilizers, fillers, colorants: A comprehensive review of developments in plasticizer technology since 1952 was published (338, 339, 60, 219-222). Industrial practice in protection of plastics against ultraviolet light was described; the three types of compounds used are salicylic esters, hydroxybenzophenones, and benzotriazoles (340). Noteworthy contributions were made relative to stabilization of vinyls (223-225, 246, 341) and cellulose nitrate (39), modification of properties of plastics with fillers (48, 68, 141, 142, 174, 226, 342, 343), coloring of plastics (344, 345), antistatic agents (346), lubricants (347), fungicides (247, 348), and catalysts for polymerization of polyesters (349, 350).

Processing

Blow molding has now become a major technique for shaping plastics with an estimated 80 million molders using the process and 100 more expected to be equipped by the end of 1960. The recent expansion of this field is attributed to the advent of high-density polyethylene having the required rigidity and toughness for blow-molded containers, housewares, toys, and industrial components, and to the recent availability of a large array of stock machines from some 28 manufacturers (91, 351-353). Improved procedures and equipment for thermoforming of sheet by air pressure and vacuum methods provides for deeper draws, sharper corners, **(To page 167)**

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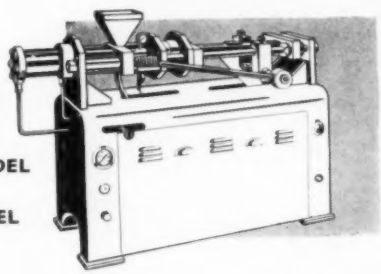
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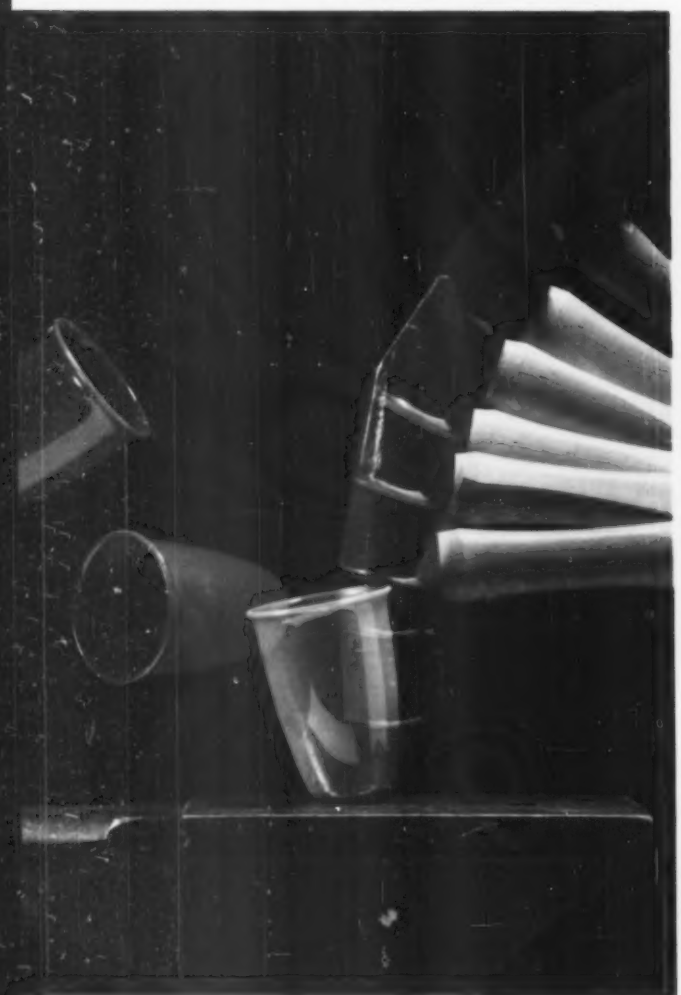
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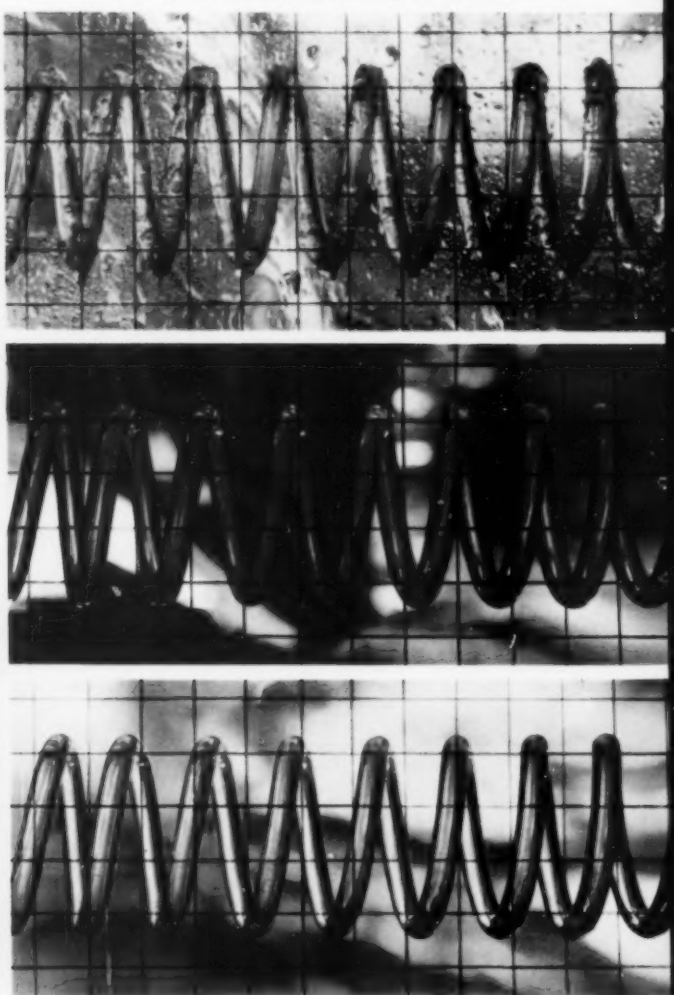
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Modulus of elasticity	
Tension	D-638
Flexural	D-740
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ELECTRICAL	
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60 cycles	
10^6 cycles	
Dielectric strength, short time	D-149
Dissipation factor	
60 cycles	D-150
10^6 cycles	
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Dry	
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8	5-6%
8	60-100%
5	12,000 psi
1	0.14%
0	11,000-13,000 psi
8	2.8-3.2 x 10^5 psi
0	3.2-3.4 x 10^5 psi
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	2.95
	2.90
9	440 V/mil
0	0.0007
	0.0100
	1.2 x 10^{16} ohm/cm
	9 x 10^{14} ohm/cm
5	12 sec

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Heat distortion	D-648	
264 psi		280°F
66 psi		290°F
Specific heat		0.28 cal/°C/gm
Coeff. of expansion	D-696	7 x 10^{-5} in./in./°C
Melting temperature		425-440°F
Crystalline melting temp.		505°F
Flammability (in./min)	D-635	Self-extinguishing
MISCELLANEOUS		
Specific gravity	D-792	1.20
Refractive index	D-542	1.587 N_D25°C
Clarity		Transparent
Water absorption 24 hr immersion	D-570	0.3%
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and uniform wall thickness (354-356). Advances in methods and machines for compression (357-361), injection (362-365), and extrusion (366-370) molding were reported. Developments in mill design (371) and potting techniques (372) were described.

Refinements in the decoration of molded products were discussed in a review that covered vacuum metallizing, painting, silk screening, offset printing, hot stamping, transfer labeling, and molded-in decoration (373-375). Innovations in fabricating plastics pertained to wet-belt grinding (376), ultrasonic cleaning (377), sawing (378), trimming (379), punching (380), fastening (381), and heat-sealing (100, 101, 382).

Applications

Research and development work in progress is expected to yield plastics suitable for use in the construction of long range missiles and space vehicles (292, 293, 383-387). Glazing requirements of future aircraft and spacecraft designed to operate at transient temperatures up to 1000° F. can be met with composite transparent structures utilizing glass as a heat shield and monolithic or laminated plastic as an inner structural member (388). Developments in adhesives for bonding metal aircraft parts were reviewed (389, 390).

Progress in the use of plastics in the home construction industry was discussed from the viewpoints of the architect, engineer, and consumer (391-393). Specific applications covered included curtain wall sealants (277, 394), coatings on masonry (57, 164, 165, 395, 396), and adhesives for flooring (397). The U. S. pavilion at the 1959 American Exhibition in Moscow represented a daring achievement in the application of reinforced plastics in architectural design; the 630 translucent premolded parts made of glass fiber and polyester resin were shipped to Russia for assembly of the columns and canopies on the concrete foundation (398).

Record manufacturers used about 40 million lb. of vinyl resin and 5 million lb. of styrene in 1959 to produce 250 million high-fidelity records (399). Recommendations for storage of sound recordings in archives were based on a 5-yr. study of materials, tapes, and molded disks (400).

Developments in rubber-resin soling materials (401-404, 240, 274) and finishes for leather (405) were described. Progress was reported in the use of plastics in agriculture (106, 406), motor vehicles (291, 407, 408), protection against corrosion in the chemical industry (409-412), electrical insulation (413, 414), films and containers for packaging (415-417), breathable films (418), nonwoven fabrics (419, 420), adhesives (421-426), and coatings (427-430). A

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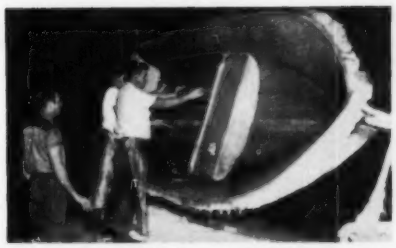
survey of design criteria and chemical resistance of plastic pipe estimated that thermoplastic pipe accounted for 95% of the dollar market, divided about as follows: 67% polyethylene, 17% ABS plastic, 14% rigid PVC, and 2% cellulose acetate butyrate (431, 432, 59, 86, 94, 109, 110, 120, 121, 178, 227-231, 294). Noteworthy applications described included oilless bearings (433), conveyor belts (434), polyester impregnants for castings (435), floor polishes (31, 436), bone-setting with polyurethane (437), and propellants (239).

Properties

The fundamental properties (438) and stability (439) of plastics as related to the chemical structure of the polymers were treated comprehensively (440). Mechanical properties investigated included tensile strength (38, 144, 312-318, 441), creep (34, 61, 119-121, 311, 442-444), stiffness (124), fatigue limit (445), dynamic loading (155, 175, 176, 278), impact strength (122, 123, 125, 126, 244, 334, 335, 446, 447), bulk compressibility (448), abrasion resistance (449), and friction characteristics (71, 72). Thermal studies covered flow characteristics (450, 451), softening points of thermosetting plastics (191, 452, 453), thermal expansion (454), specific heat (455), thermal degradation (167, 245, 266, 456), heat resistance (319, 320), and flammability (323, 457-459). Theories of diffusion of gases through polymers were discussed (460, 461); apparatus for sorption and permeability measurements was described (462, 463) and test data obtained with various plastics were presented (127-129, 183, 464-467). Other authors dealt with electrical properties (63, 64, 156, 321, 322, 468, 469), infra-red spectra (157, 470-475), photoelastic behavior (32, 33, 476, 477), ultrasonic degradation (478, 479), accelerated aging (480), and cure of thermosetting resins (146, 481).

New methods and equipment were described for the determination of molecular weights (482, 483) by osmometry (484), light scattering (485), and freezing point depression (486), for the fractionation of polymers (487), and for the computation of polymer dimensions (488). Notable papers reviewed techniques used in nuclear resonance (489), mass spectroscopy (490), infra-red absorption (491, 492), precipitation chromatography (493), radioactive tracer (494), **(To page 232)**

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"Smooth, trouble-free production for two straight years" is attributed to use of Amester 1143 by Malcolm Rearden, Plant Superintendent of Cutter Boats, Inc., shown left, inspecting the lay-up of a fiberglas hull.

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Report on International Meetings

ISO/TC 61

The 1959 meeting of Technical Committee 61 on Plastics of the International Standardization Organization was held in Munich, Germany, on October 26-31. Eighteen countries were represented by 112 delegates and observers as follows: Belgium, 1; Czechoslovakia, 6; France, 12; Germany, 15; Hungary, 1; India, 2; Italy, 15; Japan, 4; Netherlands, 4; Norway, 1; Poland, 4; Sweden, 10; Switzerland, 8; Turkey, 2; United Kingdom, 9; United States, 12; U.S.S.R., 4; Yugoslavia, 2. Japan, Turkey, and Yugoslavia were represented for the first time at a meeting of ISO/TC 61. Robert Burns (U.S.A.) was chairman of the meeting and Bert S. Montell and N. A. Skow (U.S.A.) and G. Ehlers, C. Mohr, and H. Suhr (Germany) provided technical assistance for the secretariat, the American Standards Assoc. Prof. Arthur Zinsen, Director of the German Standards Assoc. (DNA), and Henry St. Leger, General Secretary of ISO, addressed the opening plenary session.

The United States delegation was composed of W. E. Brown, leader (Dow Chemical), C. H. Adams (Monsanto Chemical), R. Burns (Materials Advisory Board, National Academy of Sciences), T. Hazen (Union Carbide Plastics), I. L. Hopkins (Bell Telephone Laboratories), G. M. Kline (National Bureau of Standards), B. S. Montell (SPI), N. A. Skow (Synthane), A. C. Webber (Du Pont), P. E. Willard (Food Machinery and Chemical), R. K. Witt (Johns Hopkins University), and E. Y. Wolford (Koppers).

New ISO Recommendations

It was announced at the Munich meeting that five ISO recommended test methods for plastics have now been published and four others approved for publication. Action on 14 other Draft ISO Recommendations was completed at Munich by ISO/TC 61; they will be submitted to the ISO Council for approval and publication at a later date.

The Committee approved four new Draft ISO Recommendations and six Draft Proposals. The Draft ISO Recommendations describe methods for the determination of Vicat softening point, viscosity number of polyamide resins in solution, acetone-soluble matter of phenolic molding materials, and thermal stability of polyvinyl chloride and related copolymers and their compounds by the discoloration method. The Draft Proposals pertain to methods for stiffness of plastics as a function of temperature, changes in mechanical properties after contact with chemical substances, resistance of plastics to natural light and to artificial light, tensile properties of plastics, and the determination of maximum temperature and the time taken for temperature to rise during the setting of unsaturated polyester resins.

Activities of working groups

Working Group No. 1 on Nomenclature and Definitions is compiling definitions and terms supplementing the list of equivalent terms in the three official languages (English, French, and Russian), which is ready for submission to the ISO Council. Standardization of abbreviations for plastics materials will also be undertaken by the Group.

Working Group No. 2 on Mechanical Strength Properties is considering methods for the determination of impact, tensile, shear, and compressive strengths of plastics and modulus of elasticity.

Working Group No. 3 on Standard Laboratory Atmospheres and Conditioning Procedures is studying conditioning of polyamides, methods of producing atmospheres of specified relative humidity in small enclosures, and conditioning for resistivity and insulation resistance measurements.

Working Group No. 4 on Thermal Properties has work under way on flammability of thin films, flow of thermoplastics including high-density polyethylene and polypropylene, a modification of the Vicat softening point apparatus, flow and softening point of thermosetting plastics, and low temperature brittleness tests.

Working Group No. 5 on Physical-Chemical Properties is drafting methods for determination of the percentage of chlorine in vinyl chloride polymers, acetate in vinyl chloride-acetate copolymers, and monomer and low molecular weight polymer in polyamide resins, viscosity of concentrated polyamide solutions, water content of polyamide resins, and index of refraction of transparent plastics.

Working Group No. 6 on Aging, Chemical, and Environmental Resistance is preparing methods for determining loss of plasticizers by the oven method, biological attack on plastics, natural and artificial weathering of plastics, and environmental stress-cracking.

Working Group No. 7, which is working on Preparation of Test Specimens, is considering basic techniques to be used in preparing molded test specimens for the determination of strength properties.

Working Group No. 8 on Electrical Properties is collecting information on the reliability of the tracking test, reviewing draft methods for testing solid insulating materials developed by IEC/TC 15, and studying the corrosion of metals in contact with plastics when they are under continuous potential difference.

The new Working Group No. 9 held its first meeting at Munich under the leadership of Switzerland. It was decided that the first work of the group will deal with phenolic molding compounds, industrial phenolic laminates, and rigid polyvinyl chloride compounds. The ISO specifications will be limited at this stage of analysis to listing the properties to be measured and to specifying the methods and test specimens to be used.

The 1960 meeting of ISO/TC 61 will be held in Prague, Czechoslovakia, in October. The Committee was invited to meet again in Italy in 1961.

IUPAC macromolecular commission

The Macromolecular Commission of the Physical Chemistry Section, International Union of Pure and Applied Chemistry met in Wiesbaden, Germany, on October 12-13. It was approved and published in English and French a Nomenclature for High Polymers; a translation in German has been prepared and versions in other languages are in process. Supplemental nomenclature to identify and distinguish sterically regular polymers in the various possible tactic structures is under consideration. The MC has conducted a round robin study of molecular weight determinations by viscosity, osmotic pressure, light scattering, and sedimentation methods; the results were quite variable, attributable in part to the broad range of molecular weight of the polystyrene used. A narrow fraction of anionic polymerized polystyrene is to be used in a new round robin; osmotic pressure measurements will be made first in order to determine

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whether there is sufficient low molecular weight material present to cause variable results with different membranes. A list of laboratories engaged in high polymer research together with data on their staff and facilities is to be revised and distributed to members and participating organizations.

The Macromolecular Commission sponsored a Symposium in Wiesbaden on October 12-17; five plenary lectures and 30 invited divisional lectures were delivered, in addition to many contributed papers. Registration totalled approximately 1400. The next MC Symposium will be held June 14-18, 1960, in Moscow; there will be three topics: 1) synthesis of new polymers, 2) mechanism of addition and condensation polymerization, 3) chemical reactions of polymeric chains. The MC is also proposing to organize a Symposium in conjunction with the XXIst IUPAC Conference (August 2-5, 1961) and XXVIIth IUPAC Congress (August 6-12, 1961) in Montreal, Canada, and has been invited to sponsor a Symposium which is to be held in Calcutta, India, during February 1963.

1960 Netherlands symposium

An International Congress on the Technology of Plastics Processing will be held in Amsterdam, October 17-19, 1960 in conjunction with the Second International Plastics Exhibition "Macroplastics," October 19-26. The Congress is sponsored by the Bond voor Materialenkennis (Association for the Advancement of the Knowledge of Materials), the Koninklijk Instituut van Ingenieurs (Royal Institute of Engineers), and the Koninklijke Nederlandse Chemische Vereniging (Royal Netherlands Chemical Foundation). Organization and management will be handled by N. V.'t Raedthuys, Tesselschadestraat 5, Amsterdam.

IUPAC division of plastics and high polymers

This Division of the IUPAC Applied Chemistry Section met in Düsseldorf on October 18-19. Highlight of the meeting was a Symposium on Aging of Plastics consisting of seven lectures delivered by speakers from France, Germany, Switzerland, and the United States. These papers were preprinted in English, French, and German, and were distributed to the 1900 registrants who came from 24 countries.

The Division has prepared a document entitled "Classification of Plastics: A Critical Review." This report will shortly be in print and will be sent to interested technical and trade associations in order to obtain comments on which to base further recommendations regarding international classification of plastics. The Division also has under consideration a document proposing standardized abbreviations for plastics for use in technical, patent, and trade literature.

The IUPAC Division of Plastics and High Polymers will meet again in September 1960 in Turin, Italy, and will co-sponsor a symposium in conjunction with the 12th International Congress on Plastics. Plans are also being made for a symposium in Montreal, Canada, in August 1961 at the time of the IUPAC Conference and Congress.

Abstracts of Dusseldorf symposium papers

"The aging of plastics. Introduction, definitions, terminology, characteristics, and significance for practical application," by H. Stager, Switzerland. Some general definitions and ideas are presented relative to the pathology of plastics materials. The effects of form, physical condition, and mechanical stresses as well as technoclimatology are considered in detail.

"Chemical structure and stability relationships in polymers," by B. G. Achhammer, Max Tryon, and G. M. Kline, United States. Stability of polymers is based on ability to withstand environmental conditions and still retain the physical properties required for use in a given application. The degradation process involves changes in chemical structure of the polymers. Our present knowledge of relationships between chemical structure and resistance to various environmental parameters, including thermal, ultraviolet, and nuclear radiant energy, oxygen, water, and various climate conditions, is reviewed. Techniques used in such investigations are briefly surveyed. (This article was published in the December issue of MODERN PLASTICS, beginning on p. 131.)

"Permanent physical changes in high-polymer materials and methods of test," by F. H. Muller, Germany. The fact that high polymers in general are not in a state of thermodynamic equilibrium is the reason on the one hand that their properties, despite defined chemical constitution even in respect to molecular weight and molecular weight distribution, cross-linkage, etc., are still not sharply defined. On the other hand, for this particular reason, it is possible by means of a suitably controlled previous history, such as represented by each method of treatment, to vary certain properties to a considerable extent. Thus, by purely physical means, the properties can be changed. Since, however, even in the solid state, re-arrangements of molecules and groups of atoms resulting from thermal motion of the internal kinetics in high-molecular materials is not completely excluded—apart from the absolute zero point—the technically very important problem continuously arises: how good is the stability with time of such physically induced changes in properties? Many of these changes are found to be almost completely or sufficiently stable in a suitable temperature range, and with suitable ranges of other stresses. Others, on the other hand, degenerate producing new changes or degradations and there is no possibility to prevent such aging, it is reported.

"Creep rupture strength of plastic pipes," by K. Richard, G. Dietrich, and E. Gaube, Germany. Cold flow observed with thermoplastic materials that are exposed to mechanical stress for a prolonged period reduces the permissible stress to a fraction of the short-time strength. Pressure-pipes must, therefore, be designed as to be up to values of maximum permissible stress which are valid also for long-term exposure. It is desirable to counteract the loss of permissible stress by suitable measures. In the case of rigid PVC, attempts are now being made to improve pipe quality to such an extent that it will be possible to increase the maximum permissible wall stress from 60 to 100 kg./cm.^{2}.

This is being achieved by employment of improved pipe materials. In the case of Ziegler polyethylene. the maximum permissible stress of the pipes has also been increased from 50 to 100 kg./cm.^{2} as the result of expansion of the pipes below the melting range. Considerable reductions in price can be expected for both types of pipe. It is also probable that both types will maintain their market position because of the difference in their properties. A decisive factor is the price of the pipelines laid. Since the laying techniques for PVC and polyethylene pipes differ, pipe prices alone are insufficient to make proper calculations. A new impact-resistant PVC, which is now being evaluated, shows promising creep rupture strength behavior and appears to offer a maximum permissible pipe wall stress of at least 100 kg./cm.^{2}.

"Stress-cracking **(To page 227)**

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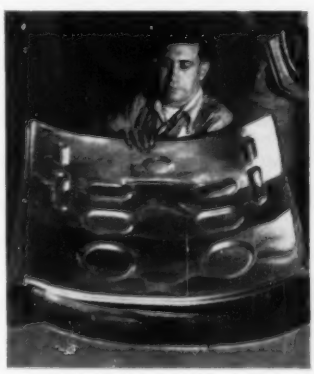
Additional advantages increase the range and value of Maraglas applications. These supplement previous conveniences such as easy mixing—with no melting, no special equipment —to produce bubble-free castings in any size and shape, with 90% light transmission, durability, and weather resistance. New Maraglas epoxy resin-and-hardener systems provide tough, high-impact end products without brittleness; simpler cures and higher heat resistance with no sacrifice of clarity.

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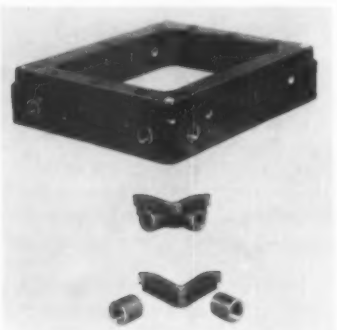
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NEW DEVELOPMENTS

Many minds at work on new ways to use plastics, new designs, and new product concepts offer ideas you can use.

Design trick for stronger inserts

A reinforced plastics part for the casing of a welding transformer required four threaded sleeve inserts in a rectangular part—two on each side of the corners at one end of the part. Individual inserts loosened under rigorous torque tests. This problem, at Grand Haven Plastics Co., Grand Haven, Mich., was solved by welding two of the threaded inserts to a steel strip bent at a 90° angle and using the assembly as a single insert in each corner of the piece.



By this design trick, strength specifications were fully met and the molder gained the advantage of producing four mounting holes with only two inserts. The steel strip distributes stresses throughout the entire corner rather than concentrating them; anchoring is made still more positive by splitting and flanging the ends of the steel angles to produce increased bearing within the molded structural material. During molding, the steel angles are located by a pair of pins projecting into the threaded sleeves. Glass-reinforced polyester molding compound used for the job was Atlas' Thermoflow 100.

Nylon collets cut costs, reduce breakage

Machined from extruded rod, nylon collets are helping to process fragile tubular ceramic dielectric units with an 80% reduction in breakage, an original collet cost of about one-third that of tool steel, and almost twice the service life.

At one stage in the manufacture of the ceramic units at The Erie Resistor Corp., Erie, Pa., they must be fed, gripped, processed, and discharged rapidly. Using tool steel collets for gripping, breakage rate was 8 percent. When nylon collets were tried, breakage dropped to 1 percent. While the nylon collets wear oversize at about the same rate as steel—after processing 15,000 units—they can be rebored to handle the next size larger ceramic tubes and are then good for processing another 10,000 units; when worn, steel collets have to be replaced.

In machining the nylon collets from Polypenco rod, supplied by The Polymer Corp., Reading, Pa., cost per collet was only 34¢ each, as compared with $1.00 each for steel. Nylon rod costs several times as much as steel rod for the same purpose, but the saving comes about because of three major factors: nylon can be machined about twice as fast as steel; there is less waste material because there is no "bark" to be removed with nylon as there is with steel; and the several time-consuming operations required for hardening tool steel are completely eliminated when nylon is used.

The Erie Resistor dielectric element operation requires 2000 collets per year for the production of ⅛-in. diameter units. Cost for steel collets: $2000. For nylon: $680. But each of the nylon grippers can be rebored to produce 10,000 units of 3/16-in. diameter, at more savings.

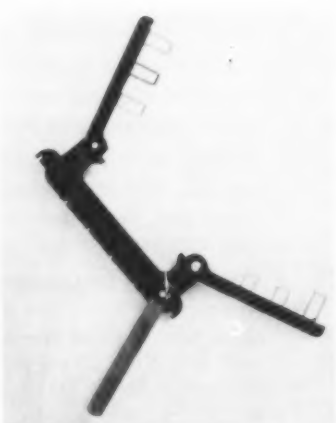
In addition, Erie Resistor reports that the design of these collets is stable enough to consider injection molding rather than machining. On this basis, with a mold cost of $560, collets can be produced at a cost of only 8¢ each, or a total for the first year's requirements of $720. But from there on, with mold cost written off, the annual requirement of 2000 collets can be produced at a total cost of only $160!

New uses for butyrate

A number of manufacturers have recently turned to butyrate for a solution to some of their design problems. Here are some examples of what they did, and why:

Extrusions: A transistor radio receiver, housed in an extruded blue butyrate case, is part of an electronic lecture system which guides visitors in museums, art galleries, business shows, etc. The system, developed by Lectour Inc., Washington, D. C., consists of a separate transmitter, transmission line, antenna, and sound source for each viewing area. The receiver, slightly larger than a fountain pen and weighing less than 4 oz., picks up transmissions emanating at each viewing area. The case is extruded by Anchor Plastics Co. Inc., Long Island City, N. Y.

Other recent items of extruded butyrate are: an electric power cable conduit, Polychemical Industries Ltd., Edmonton, Alta., Canada; garden insecticide **(To page 176)**

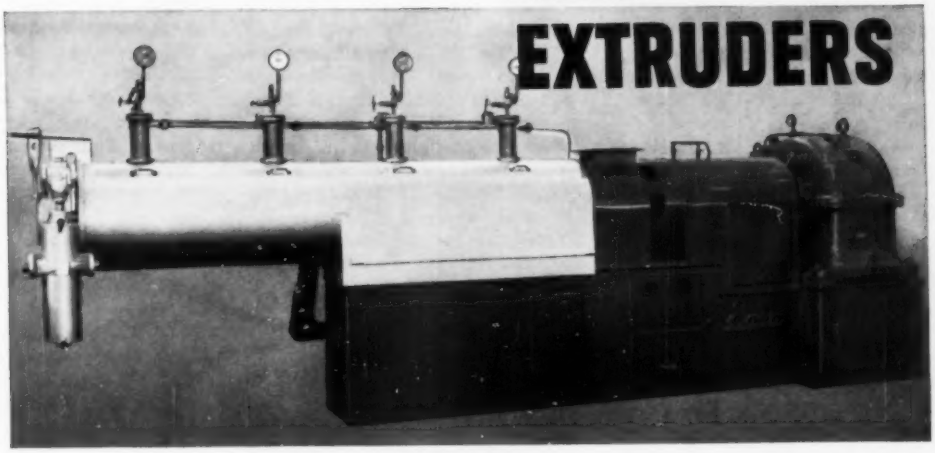


INJECTION MOLDED butyrate spark plug tool, showing gap gages, electrode adjusters, gasket rejector slots, and electrode file.



EXTRUDED BUTYRATE case houses radio receiver component of electronic lecture guide system, has tiny headphone unit.

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(*From page 174*)

sprayer, Anesite Co., Chicago, Ill., with trim molded by Wollin Products, St. Joseph, Mich.; seasonal sign faces of butyrate sheet for Schlitz Brewing Co., Everbrite Electric Signs Inc., Milwaukee, Wis.; fishing rod carrying case, Sanco Plastics, Culver City, Calif.; and channeled holders for rubber weatherstripping, Anchor Plastics Co. Inc., Long Island City, N. Y.

Injection molding: Spark plug gap gages for Electric Auto-Lite Co. and Champion Spark Plug Co., both Toledo, Ohio, are molded of butyrate because of the toughness and resistance to grease and gasoline.

The Auto-Lite tool is circular in shape, has electrode adjusters and six gap gages, and features a methacrylate magnifying lens in the center. The tool is molded in a four-cavity mold by Watertown Mfg. Co., Watertown, Conn.

Champion's four-in-one tool contains electrode adjusters, gap gages, gasket rejector slots, and an electrode file; molded by Anderson Assocs. Inc., Toledo.

Other recent applications of injection molded butyrate, and the molders involved are: transparent bodies for a grease gun and oiler, Minnesota Plastics Corp., St. Paul, Minn.; heavy-wall lenses for floating distress marker lights, Crescent Mold Engineering Corp., N. Hollywood, Calif.; housing for ignition timing light, Recto Molded Products Inc., Cincinnati, Ohio; vacuum cleaner rug nozzles, brush adjustment screw, and foot pedal motor control for Eureka Vibra-Beat model, Napco Plastics Inc., Napoleon, Ohio; and the transparent roof of a school bus pull-toy, Trimold Inc., Kenmore, N. Y.

Thermoforming: Giant letters for dealer showroom signs are now formed by Everbrite Electric Signs Inc.; huge bowling pins for an outdoor display are vacuum formed by Multiplastics Inc., Addison, Ill., from sheet extruded by Midwest Plastic Products Co., Chicago Heights, Ill.

Plastisol saves 35%

In producing the Filtronic air filter, material and assembly costs are reduced 35% by the use of molded-in-place vinyl plastisol for embedment and sealing of the filter element.

The filter, manufactured by Fram Corp., Providence, R. I., has a pleated paper element which must be held securely in place, top and bottom, and gasketed against air leakage. In the former production method, four separate steps and materials were required: 1) fabrication of a stamped metal ring; 2) fabrication of a cut rubber gasket; 3) adhering of paper element to metal ring; and 4) adhering of gasket to metal ring.

The plastisol compound now used is Chem-o-sol, manufactured by Chemical Products Corp., E. Providence, R. I. It is specially formulated to be fast-fusing and to resist wicking, high temperatures, and gasoline fumes. The former metal ring and the paper-to-metal adhesive is eliminated, also the cut gasket as well as its adhesive, since the plastisol in the completed unit serves as a gasket



between the filter and metal silencer housing.

At the Fram plant, the pleated paper element is inserted between a perforated metal outer shell and an inner wire screen. Chem-o-sol is flowed into a low-profile ring mold, the assembled filter parts placed into the mold, and the entire unit conveyed at a controlled rate through a fusing oven.

When fusion is completed, the unit is taken from the oven and inverted. The ungasketed filter end is placed into a second ring mold, which has been filled with the liquid plastisol. Oven fusing is repeated, the unit again removed from the oven and air cooled, the molds stripped off, and the completed filter inspected and readied for shipment.

Ribbed tote boxes

Utilizing ABS, (acrylonitrile-butadiene-styrene) a material that has been growing in importance in the tote box field, Export Corp., Detroit, Mich. has designed "bins" with a new feature—ribbing for easy installation of dividers. The boxes were designed particularly for use by the electronics industry for efficient and safe handling of precision parts, but can be adapted for food handling and many other operations.

The tote boxes are formed of Seilon S-3, a high impact ABS polymer furnished by Seiberling Rubber Co.'s Plastics Div., Newcomerstown, Ohio, using an adaptation of a vacuum-plug assist technique. Mold construction varies because of differences in depths of draw. Some are single cavity and some are multiple. Wall thickness is standard for all boxes.

The transparent, snap-on cover, vacuum formed in a multi-cavity mold, using Tenite butyrate, is designed to facilitate stacking as well as to control dust and dirt. In addition to the new ribbed construction, the ABS boxes offer durability, high strength, chemical resistance, noise reduction, and prevention of part damage. Thus, although the box does not represent a cost saving in itself, the manufacturer feels that the combination of advantages make it an economical item.

. . . And in brief

• Vacuum formed containers for candies, cookies, fruits, jewelry, hardware, etc., contoured to the shape of the item being packaged, are marketed by National Packaging Corp., Ft. Wayne, Ind. Formed of PVC, impact styrene, and oriented styrene, the units permit packaging at savings to 50 percent.

• Vinyl molding is used as a "bumper binder" for desk top edges. Extruded by Waljohn Plastics Inc., Brooklyn, N. Y., the molding snaps into place in an aluminum frame; no adhesive is required. Diamond Alkali supplies the PVC.

• Safe-T-Serv battery filler has self-closing valve that automatically fills batteries to proper level, cutting servicing time in half. Capacity is a little over 2 quarts. Molded for Topper Mfg. Corp., Torrance, Calif., by Modern Plastics Co., Los Angeles, using Tenite polyethylene supplied by Eastman. Retails at $5.95.

• Ironing board covers using laminate of aluminum foil and acetate film are now being produced by Trio Mills Mfg. Corp., New York, N. Y. Laminate is placed under conventional cotton drill fabric. Heat is reflected and spread by aluminum, acetate film provides tear resistance. Acetate by Celanese Plastics Co.

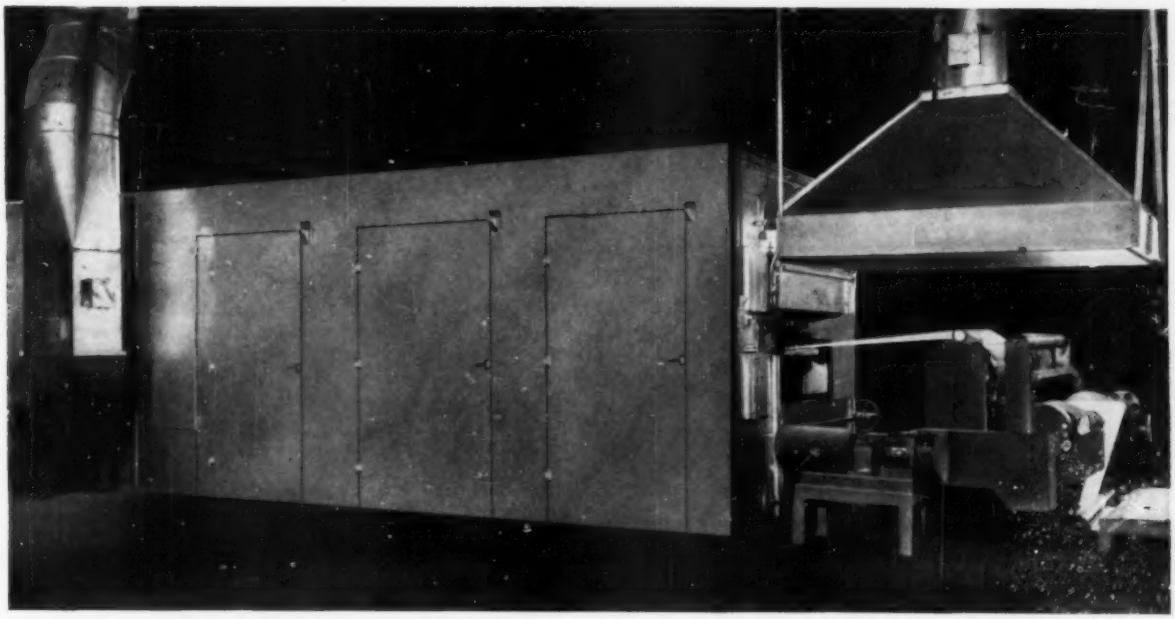
• Drain fittings of nylon have replaced metal varieties in soft-drink vending machines made by Glasco Corp., Muncie, Ind. Claimed advantages are lower cost and superior performance. Molder is Cyanede Plastics, Henderson, Ky., using Plaskon Nylon 8200 from Plastics & Coal Chemicals Div., Allied Chemical Corp.—**End**

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LITERATURE

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Bauen mit Kunststoffen" (Building with plastics) *by Amtor Schwabe and Dr. Hansjürgen Saechtling.*

Published in 1959 by Ullstein Fachverlag, Tempelhof, Berlin, Germany. 452 pages in German. Price: 56DM ($14)

Written to meet the practical requirements of the builder, this volume describes the properties and fields of application of the various materials, components, and finished products. In addition to a detailed index, lists of building materials and brand names are given for easy reference. The publication is profusely illustrated, and includes many full color photos.

Plastics—the Story of an Industry. Eighth revised edition, which presents a brief overall picture of the plastics industry, touches on its history, development, types of companies involved, types of plastics, manufacturing processes, and products. Includes references on educational facilities, trade publications, and book publishers. 42 pages. Price: 30¢ each. Quantity prices available on request. *The Society of the Plastics Industry Inc., 250 Park Ave., New York 17, N. Y.*

Polycarbonate mill shapes. Properties, applications, machinability, availabilities, etc., for Polypenco polycarbonate mill shapes. Bulletin BR-12. 2 pages. *The Polymer Corp. of Pennsylvania, Reading, Pa.*

Flame-retardant polyethylene. Properties, burning tests, heat stability, and other technical data on Aroclor modified flame-retardant polyethylene. 4 pages, *Organic Chemicals Div., Monsanto Chemical Co., St. Louis 24, Mo.*

RP comparator. Vis-Tec Comparator, developed by engineers of Douglas Aircraft under sponsorship of Owens-Corning Fiberglas, is a materials evaluator that condenses many thousands of data units for visual and quick reference. In the form of a large slide-rule, the device allows a design engineer to compare rapidly specific properties of 12 proprietary laminate materials. On reverse side are charts and tables compiled from military sources and manufacturers' literature that bring together basic design criteria the engineer needs for initial evaluation of various laminate systems, enables him to evaluate any property of fibrous glass quickly. Price: $6.00. *Visualized Technical Sciences Inc., Box 43064, Los Angeles 8, Calif.*

Transparent plastic containers. Catalog describes a line of transparent plastic boxes, counter dispensers, and novelty containers. Catalog B-59. 16 pages. *Weinman Brothers Inc., 3260 W. Grand Ave., Chicago 51, Ill.*

Polypropylene. "Some Pertinent Facts on Polypropylene Film." 4 pages. *AviSun Corporation, Marcus Hook, Pa.*

Polystyrene sheet and film. Portfolio describes properties, uses, etc., for Polyflex oriented polystyrene sheet and film. Includes a number of samples. *Plax Corp., P. O. Box 1019, Hartford, Conn.*

1,2-Butylene oxide. General description, properties, uses, handling precautions, etc., for 1,2-butylene oxide, a PVC stabilizer, catalyst, and organic intermediate. 5 pages. *The Dow Chemical Co., Abbott Road Building, Midland, Mich.*

Chemical catalog. "Fisher Chemical Index" lists alphabetically practically every chemical that is available commercially. Includes nomenclature, technical information, shipping regulations, prices, etc. Catalog 123. 366 pages. *Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.*

PVC resins. Technical data on a line of new PVC resins for flooring, injection molding, calendered film and sheeting, rigid and semi-rigid products, and coating applications. 4 pages. *Escambia Chemical Corp., 261 Madison Ave., New York 16, N. Y.*

Pigments. "Ferro Paste Color Concentrates for Polyester Resins" outlines the colors available, gives prices, etc., and includes a color chart. 9 pages. *Plastic Color Section, Ferro Corporation, 4150 E. 56th St., Cleveland 5, Ohio.*

Laminated plastics. Application information and engineering data on laminated plastics and vulcanized fibre for electrical, electronic, and mechanical components. 8 pages. *Taylor Fibre Co., Norristown, Pa.*

Acrylonitrile - butadiene - styrene. Booklet describes uses, advantages, etc., for Kralastic MM, an ABS-blend and compares its properties with nylon 6/6. 4 pages. *United States Rubber Co., Naugatuck Chemical Div., Naugatuck, Conn.*

Laminated plastic sheet, tubing, rod. Available grades and properties, applications, fabricating and finishing information, etc., for Panelyte laminated plastic sheet, tubing, and rod. Includes phenolics, melamines, epoxies, and silicones with paper, asbestos, canvas, cotton, nylon, and glass fabric bases. 18 pages. *Cadillac Plastic & Chemical Co., 15111 Second Ave., Detroit 3, Mich.*

Plastic Structural Sandwich Panels in an Elementary School is a study made possible by the Market Development Department of the Plastics Div. of Monsanto and the Department of Architecture, Massachusetts Institute of Technology. Illustrations and text discuss architectural development, structural analysis, etc. 46 pages. Price: $3.00. *Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.*

Injection molding. "An Executive Look at Hidden Injection Molding Costs" gives an analysis of obsolescence and certain competitive factors in injection molding operations. Shows how hidden costs of molding problems and obsolescence on standard injection machines affect proprietory and inplant molders. 16 pages. *Injection Molding Surveys, 3514 Lee Rd., Cleveland 20, Ohio.*

Polyethylene. Describes uses, processing techniques, properties, etc., for Rigidex high-density polyethylene. 22 pages. *British Resin Products Ltd., Devonshire House, Piccadilly, London W1, England.*

Finishing systems. Specifications, uses, etc., for a line of spray guns, automatic spray coaters, flow and dip coaters, industrial ovens, air compressors, dust collectors, spray booths, industrial washers, hot spray systems, paint tanks **(To page 180)**

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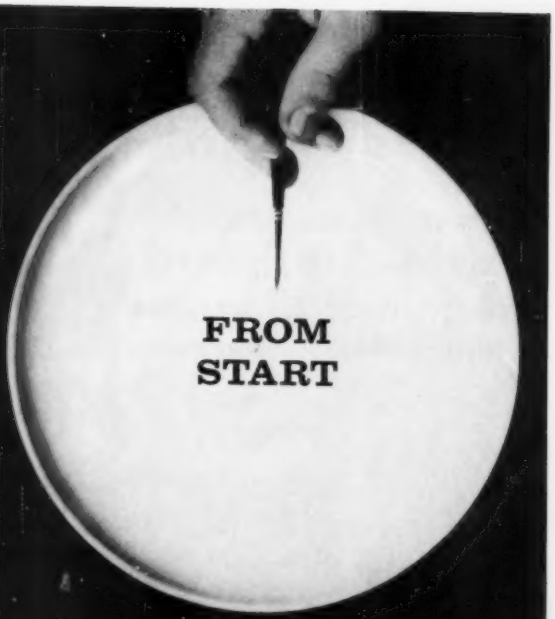
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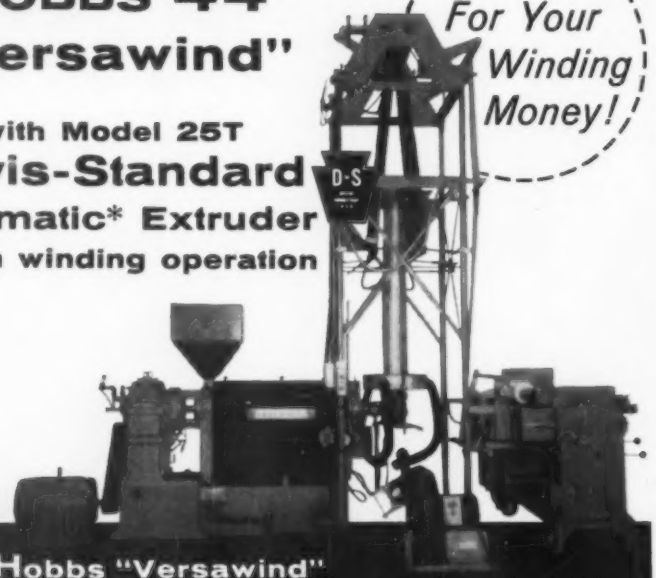
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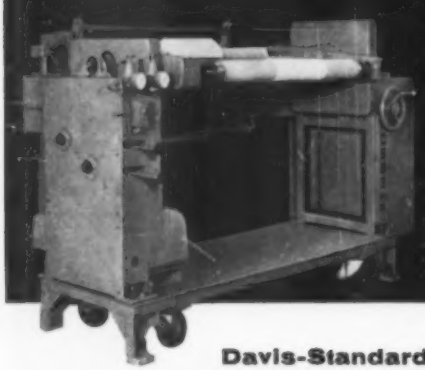
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and pumps, hose and connections, conveyors, and phosphatizing systems. Bulletin F-325. 4 pages. *The DeVilbiss Co., Toledo 1, Ohio.*

Thermocouple Wells and Complete Assemblies describes well designs and dimensions, pressure and temperature ratings, corrosion data, thermocouple assembly data, and ordering and pricing information. Catalog G102-1. 18 pages. *Minneapolis-Honeywell, Wayne and Windrim Aves., Philadelphia 44, Pa.*

Air-hydraulic boosters. Specifications and technical data for a line of air-hydraulic boosters used for laminating, molding, bending, blanking, feeding, welding, clamping, compressing, embossing, testing, riveting, etc. Includes four pages of field applications. Bulletin B-200P. 24 pages. *Miller Fluid Power Division of the Flick-Reedy Corp., Bensenville, Ill.*

Product catalog. Directory lists specifications, end-uses, and other data for over 1000 products manufactured and distributed by the company throughout the world. 36 pages. *The Borden Chemical Co., 350 Madison Ave., New York 17, N. Y.*

Pyrometer indicator. Features, applications, standard ranges, and specifications for Types Z21 and Z23 pyrometer indicators. Bulletin 0031 (2 pages). Bulletin 0032 (3 pages). *Atlantic Pyrometers Inc., 190 Warburton Ave., Hawthorne, N. J.*

Mass and paste mixers. Specifications, features, uses, etc., for a line of mass and paste mixers for mixing and kneading all types of plastics and other pastes. Catalog D. 12 pages. *Paul O. Abbé Inc., 154 Center Ave., Little Falls, N. J.*

PVP/VA copolymers. Formulations, product data, viscosity ratings, compatibility, physiological data, etc., for a line of vinylpyrrolidone/vinyl acetate copolymers. Bulletin AP-88. 20 pages. *Antara Chemicals, General Aniline & Film Corp., 435 Hudson St., New York 14, N. Y.*

Fluorescent pigments. Three technical bulletins give instructions for using Day-Glo fluorescent pigments as a colorant for many types of plastics. "Switzer A&D Series Daylight Fluorescent Pigments in Polyethylene" Bulletin 1148, 1 page ". . . in Polyester Resins," Bulletin 1149, 2 pages, and ". . . in Polyvinyl Chloride Resins," Bulletin 1150, 2 pages. *Switzer Bros. Inc., 4732 St. Clair Ave., Cleveland, Ohio.*—**End**

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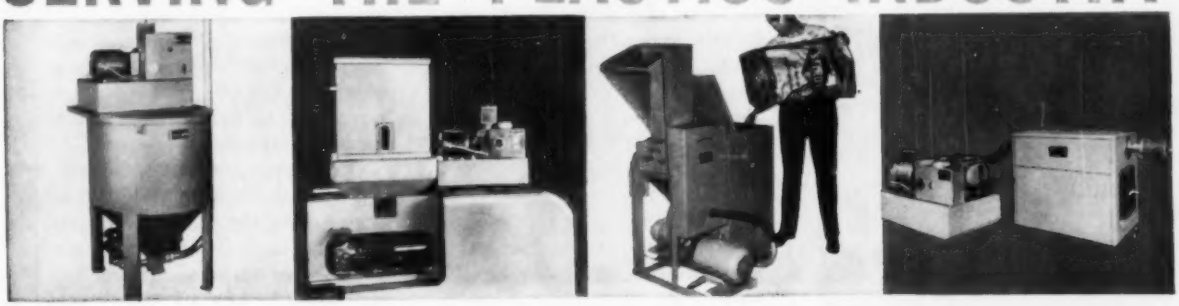
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Methacrylate

(From pp. 106-107)

Since 1959 was a big year in refrigerators and washing machines it was also good for methacrylate medallions and escutcheons or decorative features on those appliances. Jewelry, brush backs, molded lenses, small signs, also went along as usual in 1959.

There is a possibility for the development of a new compound that will withstand ultraviolet from mercury vapor lamps in street lights even better than ever before and thus, because of its light weight, give methacrylate another selling point in competition with glass.

A prominent methacrylate item in England is telephone hand sets, but there are practically none in this country. Compression molding of methacrylate in England is not uncommon but the granular powder sold there is 8¢ under the price of standard material. In the U. S. it is 53¢, compared to standard 55¢ material, and has not been used to any great extent.

The extrusion section consumes only a few million lb. a year. A good portion of it is in lighting troughs, but increasing amounts are going into extruded flat and corrugated sheet. Like presently available extruded sheet, it will have economic advantages in thin gages over cast sheet for use where optical properties are not critical, but even that deficiency may soon be overcome. It is available in transparent, translucent, and opaque grades—is suggested for auto and boat trim, building facings and decorations, fluorescent lighting, and signs. But Du Pont, after years of struggle, thinks it has perfected a new compound developed exclusively for extrusion that will prove to be quite popular.

Cast sheet is in much larger volume than molding and extrusion material. Estimates for 1959 vary from 45 to 65 million lb., compared with estimates of 40 to 55 in 1958. Lighting panels, signs, and glazing are the important applications, but its growing use for skylights in construction is a promising market.

Implex, the high impact methacrylate introduced by Rohm & Haas three years ago is growing nicely. The company added three new formulations in 1959. A customer can now choose according to his desire from formulations that are suggested for 1) toughness; 2) greater surface gloss for such things as razor housings; 3) resistance to staining for piano keys; and 4) superior heat resistance for beverage vending machine canisters.

Implex has by now taken over a great portion of the spike heel business used on women's shoes. Other applications are combs, pipe bits, trays, and others requiring impact with resistance to staining. An interesting new product in 1959 was a set of jet black salad bowls, with vacuum-metallized bases, that retails for $9. Reasons: looks like ebony, resists breakage, has surface sheen, won't stain, does not impart or pick up odors; unaffected by oils, salts, etc.

Two comparatively new materials developed from methacrylate monomer made good progress in 1959. One was a lacquer for automobiles. The entire line of G. M. cars is reported to have been coated with this baked-on material in 1959.

Du Pont's methacrylate sirup for fibrous glass panels is used by several companies, but it is still in its infancy. The methacrylate replaces polyester resin and is particularly applicable because of its weathering properties.

Toward the end of the year, Du Pont announced expansion of its monomer capacity by 40 percent. This means that Du Pont now has three times as much capacity as it had in 1956. The company announced it was expanding to take care of anticipated needs in lacquers, paints, sirup, and the new extrusion compound.

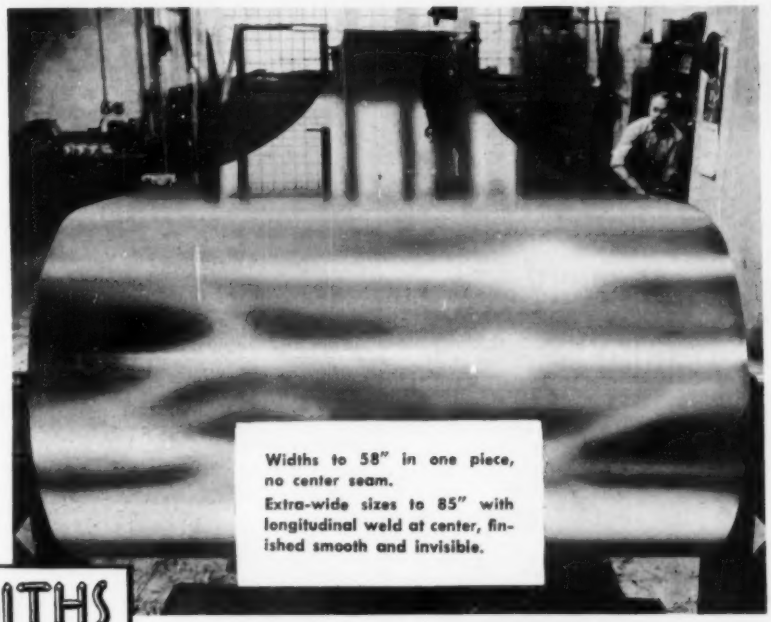
Other companies are still looking over the methacrylate situation. Among those so reported are Escambia and Sohio. There are various companies already in the acrylate business—Celanese, Union Carbide, Oronite—but so far they have given little indication of getting into methacrylate. Before the Du Pont expansion, the estimated capacity of the combined methacrylate and acrylate monomer industry was at from 130 to 150 million pounds.—**End**

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Polyethylene

(From pp. 91-96)

used for injection molded housewares and toys is a blend—generally in the 0.930- to 0.940-density range in order to obtain stiffness greater than in conventional polyethylene and an easier flow than in the characteristic high-density resins of the 0.950-0.960 range.

It is not expected that low-pressure PE is going to steal the entire molding market away from conventional polyethylene. The latter's flexibility, low cost, and ease of molding are potent properties. A low-pressure producer estimates that in 1962 linear polyethylene will be 160 million lb. for injection molding and conventional will be 90 million, but the high-pressure producers are not willing to concede that great a margin, by any means.

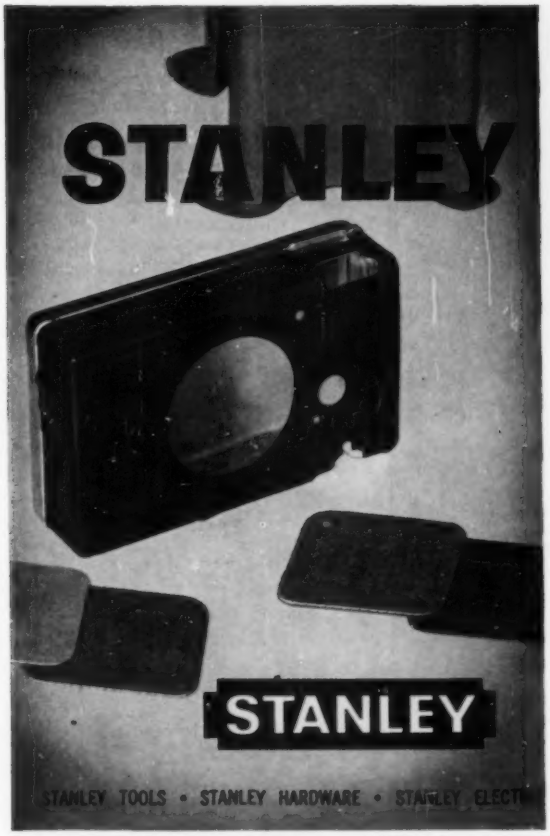
Competition from polypropylene is also expected to show up in this field in a big way by 1961, and Union Carbide Plastics' new polyethylene copolymer, which has extra good flow and high impact at low temperatures, is expected to invade a substantial part of this market such as garbage cans, buckets, and other large moldings.

Pipe production, beset with price and standardization problems, has been up and down the last two years. The 62-million-lb. figure in the table on p. 92 is subject to dispute. Some think it is high—others believe that total put-through including scrap is much higher, at least 70 million. In some cases wall thickness has been cut one third by use of a premium price 0.933-density resin, but total volume of resin used continues to increase. The 62-million-lb. figure includes nonstandard sizes and some types of tubing. Low-pressure high-molecular-weight type resins are expected to make a large-scale invasion of this field. One of its advantages is claimed to be that it will permit thinner walls with high burst strength.

Blow molding probably created as much excitement as anything in the polyethylene field in 1959. The number of machines installed is multiplying at a rate that is hard to comprehend. This market was once confined primarily to squeeze bottles and tubes made from conventional polyethylene. They still consume the largest volume in this field, but rigid bottles and toys from high-density resin are believed to have consumed at least 6 million lb., and in a year or so will probably form the major portion of the market. The real big item is expected to be detergent bottles. A material for detergent bottles had been under study for a long time but ran into environmental stress cracking problems until Hercules finally came up with a high-molecular-weight, high-density resin that seems to have solved the problem. Other producers quickly followed, and suitable resin is now available, but tooling up to handle the job takes time. It is assumed that nearly all detergents will eventually be distributed in polyethylene bottles. The amount of resin required is estimated at all the way from 30 to 60 million pounds. The year 1961 is going to be a better time to make estimates on this market than 1959.

The export market has been climbing at a rate of 50 to 60 million lb. for several years. It may continue to climb for another year or so. But eventually it must decline because of the many plants being built around the world. One estimate is that there is now capacity for almost 800 million lb. of high-pressure polyethylene abroad, with 580 million in Europe alone and approaching 100 million in Asia. Canada has about 100 million. This figure is expected to be doubled by 1964. And this takes no account of the low-pressure plants where the ratio of linear to conventional is much higher than in the United States. Nevertheless, there is a possibility that export tonnage may increase in 1960 and continue at a 250- to 300-million-lb. rate for two years, after which it may start a decline to a 125 to 175 million rate for an indefinite period.

Wire and cable coating has shown a stable dependable increase of from 12 to 20 million lb. a year—has more than doubled from 45 million in 1955. This is a specialty resin that sells in the 46½¢-range and three high-pres-



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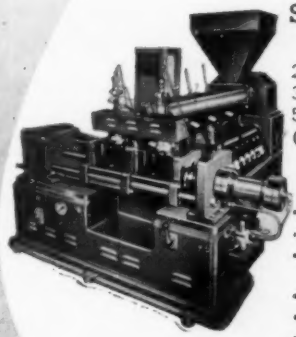
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sure producers hold most of the business. There is only a limited amount of linear polyethylene in this field, but the producers insist that they will be major contenders for the market within a short time with a high-density, non-stress-cracking resin that can be useful in thinner wall insulation and thus save weight and money.

The conventional polyethylene used for wire coating is generally of high molecular weight with a very low melt index. It must not stress crack, and the users would like a low temperature brittleness resistance at —100° F. and want it to last for 40 years.

The miscellaneous figure allows room for adjustment when the final figures are in, and in addition to some off-grade resin there are such things as monofilament, foam, calendered sheeting, compression molded or cast sheet for a radiation barrier, extruded gasketing, and floor wax.

By far the largest volume of polyethylene resin and the greatest growth volume is in film. Estimates from various sources for 1959 vary from 290 to 340 million pounds. The wide variation stems from uncertainty of sales in the last quarter of the year; it seems pretty definite that last half-year sales were not as high as the first half. Some of the film producers built up extravagant resin inventories earlier in the year and consequently purchased less resin late in the year. Part of the uncertainty was also due to film price movements. The basic price of film early in the year had been 53¢/lb., minus various discounts according to quantity and payments that amounted to around 8 percent. But there has been constant nipping at this price, and in many cases the converter doesn't know what he is going to pay for his next order. Sometimes he even held up his order waiting for a new price break. On the other hand, there is some reason for believing that a poor profit, rather than a poor volume, situation led to the grousing. Converters, too, joined in the "no-profit" hubbub and complained that the little fellow was going to be forced out of business. However, the principal film grade resin producers were operating at near capacity

all year, even hard-pressed to supply their customers at times—new entrepreneurs were unafraid to enter the film field and there seemed to be a trend toward setting up of more regional converter plants to serve local areas.

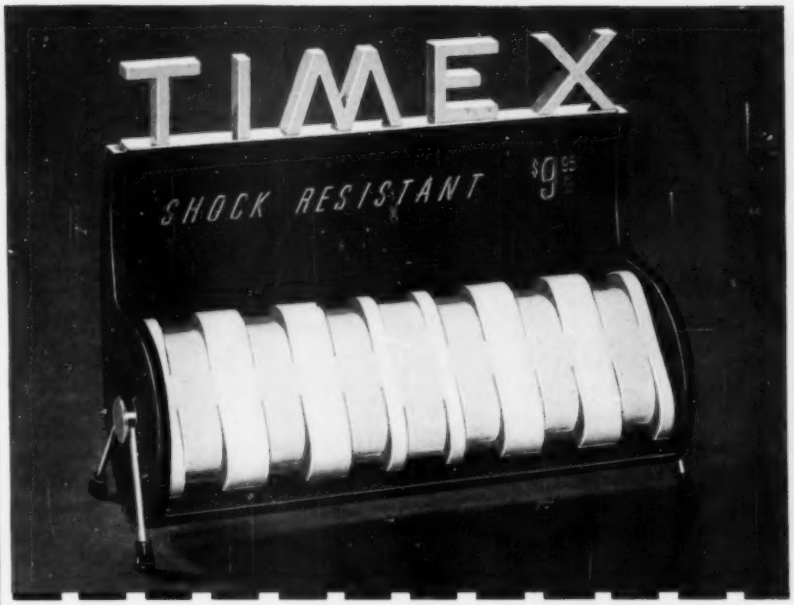
The future pattern of the film business is hazy. Most resin makers now have film-producing subsidiaries or close connections that amount to the same thing. Some of them are integrated all the way down through the converter level—start with a resin and come out with a printed bag or wrapper. Several of the largest converters are now making or soon will be making their own film. Large users of film are beginning to make their own—a candy maker who uses 2 or 3 million lb. a year has put in extruders.

A significant factor in PE film growth in 1959 was that more poundage was added than in any other year—some 65 to 75 million pounds. The last three years' growth figures were between 40 and 45 million each. If the growth continues at 50 million a year for the next 5 years, it will mean over 500 million in 1965, and there are many who think it will be even more. Note the table "Consumer Uses of Polyethylene Film," p. 94, which estimates a total of 540 at the end of 1963.

There are still fields in the packaging industry where polyethylene film volume could become as large as it now is in production—which at present is estimated at around 60% of the 200 million lb. used in packaging.

Most of the packaging film used today is in the bag market—the industry is expecting to do just as well in the overwrap market in years to come. For example, a 100-million-lb. market in overwraps is perhaps not far away. Flat wrapping of textiles, paper products, bread wrappers, etc., are in this classification. Looming up as future possibilities for big volume are frozen food packages and possibly meat, but there are moisture condensation problems with polyethylene and possibly F.D.A. troubles that will have to be straightened out.

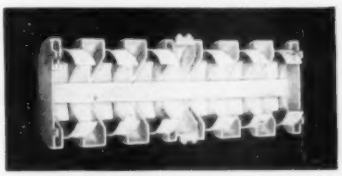
A start has already been made in bread wraps, but, so far, use has been confined to smaller bak-



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Every idea adding attractiveness and sales appeal to this wrist-watch counter display also created molding problems.

The heart of this display is a holder for the watches. From 14 watch sizes, with four different shapes of wrist bands, the retailer must be able to select any six he wishes to mount on the display holder. Because the flexible portions of this one-piece Marlex holder had to adapt themselves to these various shapes, the final detailing was left up to Watertown.



To provide contrast for the bright finish of the watches, also contrast for the hot-stamped gold lettering, the face of the display had to be a dull, satin-finish black. Yet the side rails of this modified, heat-resistant polystyrene part had to be highly polished. Sand blasting a mold to give this result called for close work between the engineers and Watertown's own Tool Dept.

The cut-out letters across the top of the display presented another problem. These are metalized by vacuum plating. Attaching these letters looked like a tricky glueing job, but Watertown engineers devised an ingenious arrangement of slots and studs which speed assembly.

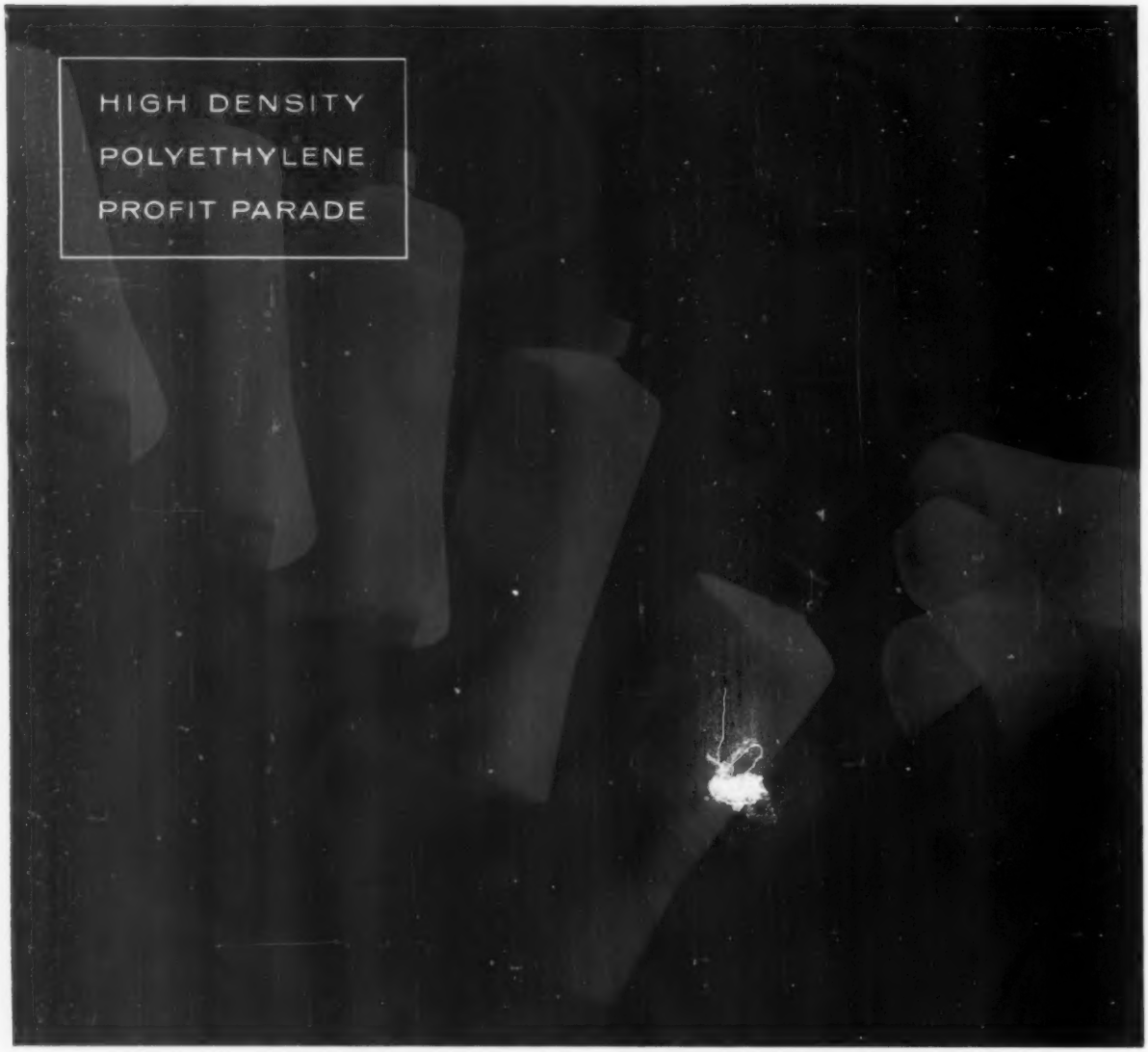
At the same time the engineers simplified the attachment of the legs — by molding them as inserts of a metalized polystyrene stud, which in turn can be fastened through a single hole with a Tinnerman nut.

Because of the heat inside shop windows in South America, all of these parts are formulated to resist temperatures of 200°F.



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High density polyethylene can be used to produce hollow objects such as these bottles that are featherweight yet remarkably rigid and strong, even in thin wall sections. Economies in production and raw materials naturally follow. In addition, these bottles are resistant to abrasion and virtually indestructible. They withstand refrigeration without cracking, autoclaving without distortion and exposure to most chemicals. Significantly, the Owens-Illinois no-drip bottles are comparable in cost with many of today's packages.

Blow molding also permits the use of Grex resins that result in superior strain-free characteristics, often difficult to achieve by other techniques.

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Blow molding is today's fastest growing fabricating technique—and no plastics lend themselves to blow molding better than high density polyethylene. This holds true whether the application is as straightforward as these Owens-Illinois bottles, or as complex as toy cars large enough to hold a child. Here are a few reasons behind the boom in blow molding with high density polyethylene:

Savings in mold and equipment costs. Because of the low pressures involved in fabricating Grex by this technique, lightweight molds can be made of easily toolable materials. Thus mold costs are ⅛ to ⅓ less than for any other fabricating method. Furthermore, blow molding is a simplified technique, often adaptable to existing injection molding and extrusion equipment.

Economies in resin requirements and cycle times. The physical properties of Grex (rigidity, heat distortion resistance, abrasion resistance) permit blow molding of thin wall sections. As a result, less resin is used per molded piece. Cycle time—even for large parts—is also reduced. Cycles in blow molding are limited only by the time it takes to cool a part. Thinner walls made possible by the characteristics of high density polyethylene speed cooling and cut cycles.

Ease of molding. Complex shapes with serious undercuts, often difficult to blow mold with other plastics, rarely present problems when a Grex blow molding resin is specified. In fact, fabricators find this technique permits use of resins having superior physical properties without sacrificing moldability. Also inherent in blow molding is the fact that costly assembly operations are held to a minimum. The large toy car, for example, is blown in a single piece.

Find out more. If you have an application for blow molding with high density polyethylene—or think you have—count on Grace for help. Write now to:

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ers. The huge volume bakers are still standing aloof. A polyethylene film with wax paper ends, a medium-density film with a low melt index, and normal film are all being tried out. Up to now the principal effort has been to replace only the cellophane on specialty breads which in itself is a 60- to 70-million-lb. market. The waxed paper bread wrapper market is up in the hundred thousand lb. volumes, but at present wax paper is less costly than polyethylene, although it is possible for PE to move in at some future time on an appearance and "longer life" sales appeal. The main problem holding back more widespread use of polyethylene bread wrappers seems to be difficulty in handling them on standard wrapping machines—that's the reason for the wax paper ends mentioned above. But the problem of handling is under aggressive attack—attachments for standard machines and new machines built from the ground up are now available. It is also possible that improved resin formulations will speed the use of film bread wrappers. Polyethylene requires more heat to seal than cellophane and is, therefore, difficult to use on a standard machine, so a resin built for the purpose may be devised. There are already specialty resins on the market for bread wrappers, but resin producers are still working to acquire a better balance of properties without raising the cost.

It will take time to convince the large-scale baker that he should alter or convert his packaging line and re-train his workers to handle a different material. However, when one of the big bakers makes the move, his competitors will follow.

The cigarette package market, with a 10- or 20 million-lb. volume, is a possibility, along with cigars. However, this tobacco market is a question mark for film because it is claimed that flavor may escape through the film. It could be that a coated film would solve this problem, but that adds a cost factor. Not too much has been heard about cigarette packaging since the Packaging Show in 1958.

Another good bet for the future is 5- or 6-mil-thick shipping bags for shipment of resins, fertilizer, and other materials that must be kept dry or free from bag fibers that brush off on the contents. This was one of the promising new developments of the year. The film was produced from Marlex high-density resin, said to be modified with rubber. These bags were originally in 10 mil conventional film—the new film produces a less costly bag and is easier to seal because it is not so thick. The new bag now costs between 25¢ and 30¢, but in some circumstances could perhaps compete with bags for salt and sugar that are in the 15¢-range, but not with multiwall bags now in the 6¢- to 8¢-area. Such bags could replace drums for shipping plastics resins if the economics are right.

There are about 2½ billion multiwall bags used annually—80% of the material used is paper and about 20% asphalt. Today the amount of polyethylene film used as one of the layers in such bags is tiny on account of economics, but the solid polyethylene bag may soon cut into the market in a fairly substantial amount.

There was an unfortunate problem arising from garment bags last year when there was an outbreak of infant deaths from smothering in the film that had been used as mattress covers. It was remedied during the year by the use of thicker film, paper-film combinations, and an information campaign conducted by members of the industry. The amount of resin used for garment bags in 1959 is estimated at about 30 million pounds. Any growth from here on will probably be slow, since polyethylene has practically absorbed the market. Future growth will depend on population—there are no more paper bags to take over in this field.

Other markets than packaging in the film field are developing at a normal rate, except agricultural uses, which are believed to have declined a bit in 1959. Educating farmers to use this material for tarpaulins, silos, and water control is a slow process. It is expected to take a long time. No big volume is foreseen until after 1965. By that time its value as a material to help water control in

ditches, ponds, earth dams, irrigation systems, will have been demonstrated. Estimators believe that such uses may require anywhere from 50 to 100 million lb. of film a year before 1970.

Extruded film for drapes and tablecloths is growing at a normal pace. Calendered film has dropped because the polyethylene drapes now popular are paper thin—too thin for production on a calender.

Use of film for barriers and see-through tarpaulins in construction and highways, now aided by 42-ft. wide sheet, is expected to grow normally each year, but is faced with a limitations threat by future competition from polyethylene-coated building paper.

Extrusion-blown film is by far the most prevalent method for producing polyethylene film today. Its tubular form is not only convenient for bag-making, but it can be easily slit if flat film is desired. Chilled roll or quenched film production is growing but it doesn't run fast enough—maybe 150 ft. a minute—while paper runs at 1000. Problems of getting rid of the water, which are multiplied when slip additives are put into the formulation, and variations in performance from day to day are headaches. The additives are needed to prevent blocking problems but they sometimes "plate-out" on a chilled roll and spoil or slow down the operation. One day the stuff runs fine, the next day it's a mess. Nevertheless, chilled film has a generally better gloss and over-all appearance and seems better adapted for flat-wrapping than blown film; but the blown-film extruders are improving their technique too with improved clarity and surfaces that would suit most any customer.

Polyethylene-coated paper, film, foil, etc., (see table on p. 93) is a nicely growing part of the industry and there are many who believe it will reach 100 million lb. in 3 or 4 years, maybe sooner.

Much of this optimism stems from the possibility of using polyethylene-coated paper milk containers. There is a good chance that polyethylene-coated stock may be less costly than either vinyl or wax. However, it may take time to convert. There is a lot of equipment involved.

Polyethylene-coated paper or board is rapidly making inroads into such markets as locker papers; multiwall bags; release papers; coated board for ice cream, bakery products, and wherever grease is a problem; and small sugar pouches where easy sealing is a requirement.

Coated foil has failed to gain in volume because it has been mostly in military laminates for ration packs and other things. So far it has not caught on for civilian goods.

But coated cellophane is a booming business. Thicknesses of from ¼ to 2 mils of polyethylene are used for bags, meat wrappers, and vacuum coating. The Mylar-polyethylene combination is also making progress, particularly in the boilable bag field.

The polyethylene barometer goes up every hour. Who wants to bet it won't reach one and a half billion by 1965?—**End**

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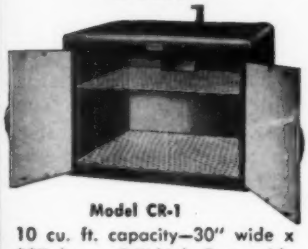
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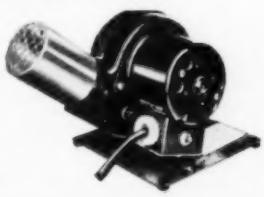
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Polypropylene

(*From pp. 96-97*)

propylene so far used has gone for molding material. Advantages claimed are ease of molding, heat resistance, stiffness, corrosion resistance. More than 100 established end-use items have been molded. Among them are knife sharpener housings, phono-record carriers, high-chair trays, tableware, cutlery trays in dishwashers, luggage handles, various housewares items, auto dome lights, ink cartridges, and hospital and laboratory ware. Experimental large moldings such as automotive instrument clusters, toilet seats, fan blades, book shelves, and similar uses look promising.

The next largest end use today is monofilaments, where hundreds of tons have been made into rope, cordage, webbing, auto seat covers, etc. Competitors in these items are already showing signs of backing out of the field.

Film is considered by polypropylene producers as one of their largest future markets, but so far there has been little around. The usual problems besetting a new material such as uniformity and production control are still in evidence. However, both Hercules and AviSun now claim to have a satisfactory film-grade resin with exceptional clarity and toughness that will run at normal machine speed. Both unoriented and biaxially oriented film are prospects, with samples of the latter showing clarity and strength properties equal to almost anything in the plastics film field.

Pipe, wire coating, and paper coating resins are prospects for the future—not too much time or resin has been available for concentration on their development.

The big markets in the future are expected to be fiber, film, and plastics with about an even division between them, according to predictions from the producers.

There have always been two criticisms of polypropylene that competitors like to cite: One is brittleness at low temperature, the other is rapid oxidation.

Producers point out that low-temperature brittleness is only troublesome in certain circumstances that can be avoided. The Army Signal Corps, for example, chose polypropylene for a telephone carrying case. The item was molded with a thick wall and no stress strains. It has withstood every required test at low temperatures. With proper design and molding there is no reason to fear low temperature brittleness, according to producers. Of course, it is not wise to mold a thin-wall container from propylene that is to be heavily loaded with ice, or even large bottles that might have to withstand frigid treatment in shipping. But a sensible use of polypropylene for molded items should avoid the low-temperature brittleness problem.

There is said to be no concern over brittleness of fibers since orientation in the manufacturing process removes any possible danger. Consequently, such things as rope or webbing would be unaffected by low temperatures.

Of all the problems that polypropylene producers have faced, stabilization has been perhaps the most difficult. Polypropylene, when it is unstabilized, deteriorates rapidly upon exposure to heat or ultra-violet light. The difficulty with proper stabilization of polypropylene is that, in general, the vast numbers of stabilizers developed for other polyolefins, vinyl chlorides, and the like proved ineffective for polypropylene.

It was necessary to develop unique systems for specific end uses. Hercules has developed four stabilizer systems that have proved remarkably effective in regard to both heat and light stability. For example, polypropylene which has the same strength at 100° C. that conventional polyethylene has at room temperature has been stabilized to where its life at 100° C. can be measured in years, and in accelerated tests at 133° C., or 272° F., life has been brought up to nearly 2000 hr., a 10-fold improvement in the even for a plastic short 2-year commercial history of this polymer.

Thus, stabilization is one of the principal keys in the successful utilization of polypropylene, and it would be well for users to understand thoroughly the stabilization systems before they determine which formulation to use for a given application.—**End**

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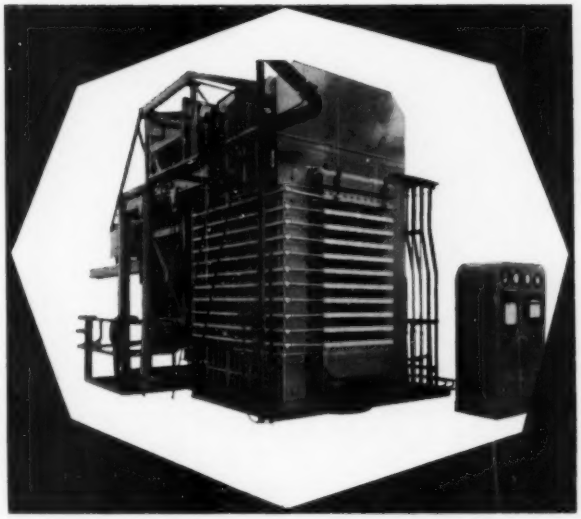
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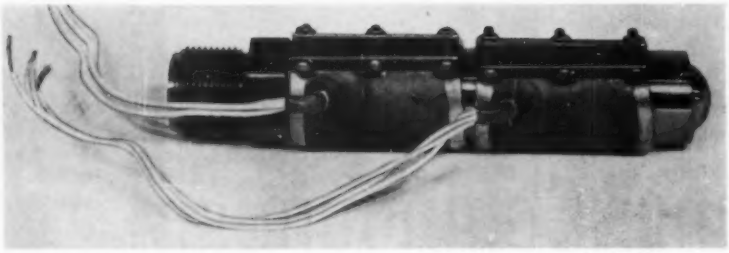
Machinery-equipment

(*From pp. 50-54*)

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Correction

"New Machinery-Equipment" (MPl, Nov. 1959, p. 48). The Rainville Co. Inc. was erroneously listed as the U. S. distributor of the Covema "Plastiniector" Injection Machine. They are not connected in any way with the sale of this machine and all queries should be sent to Covema, s. r. e., Via Fontana 5, Milan, Italy.

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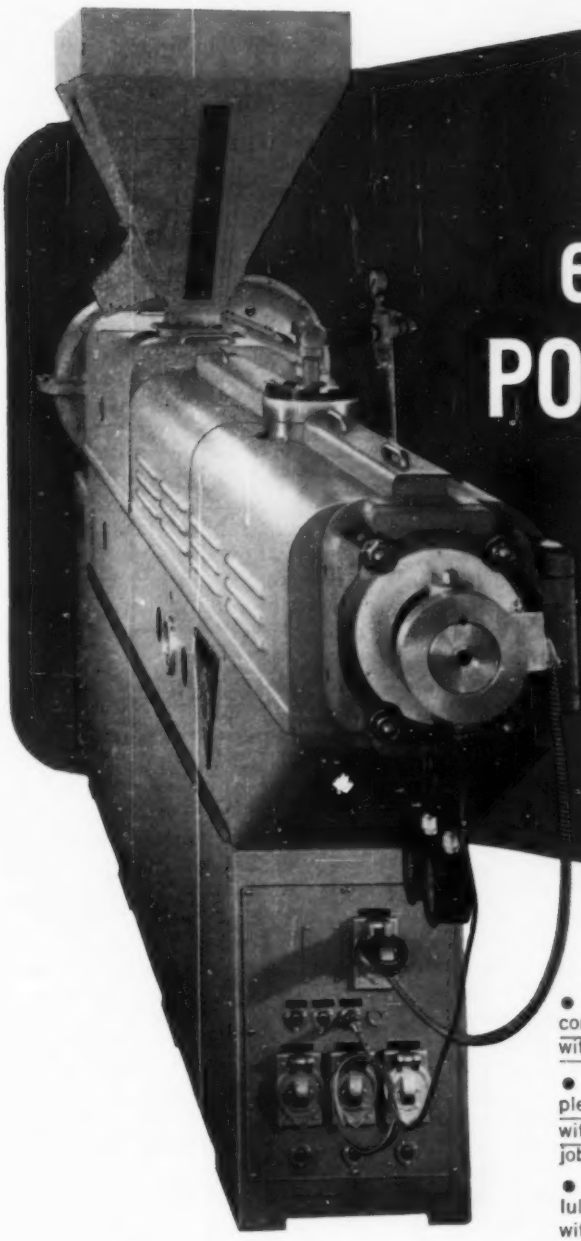
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Vinyl chloride

(From pp. 97-100)

as a covering over metal for surface protection and decoration.

The marriage of vinyl to metal should become one of the happiest marriages ever transacted in either industry. Metal may be covered with vinyl by various methods: calendered sheet or film, spread coating vinyl on a continuous roll of metal, or dip coating. The purposes are to protect the metal surface from marring or corrosion, for decoration, noise reduction, and easy cleaning. Thickness of the vinyl may vary from 1 to 20 mils for spread coating and most any thickness for calendered sheet. A conservative estimate says that around 40 million sq. ft. of vinyl coated metal sheets were fabricated in 1959.

Among applications now on the market for vinyl-clad steels are housings for room air coolers and heaters, tape dispensers, and lavatories that must be installed in small space. Other applications are coated hooks on automatic conveyor systems, parts for dishwashers and interiors of station wagons. Kitchen cabinets, refrigerators, paneling, shower stalls, and partitions are possibilities.

Plastisol and organosol or dispersion resin consumption was estimated at from 90 to 100 million lb. in 1959—would have been more except for the DOP shortage. Slush molding hasn't seemed to suffer a bit from a volume standpoint by the threatened invasion of blow molded PE toys and dolls, although most doll bodies are now polyethylene. The heads are still in vinyl because of appearance and the ease with which hair can "be attached." The huge housing on automotive air filters is another big plastisol application. Rigid plastisols have not yet grown as expected but widespread use for housings may develop.

Use of plastisol resins for spread coating on metal will probably require several years to attain real large volume.

A spread-coating of plastisols on fabric has run into severe competition from laminated film. However, it is still in the 20-million-lb. area. On the other hand, plastisol for floor coverings of the Sandura type has risen to perhaps 20 million pounds.

Use of plastisol extrusions over glass yarn for screen-cloth is steadily increasing. Compounders of the plastisol are even talking of getting into the business.

Vinyl foam made from plastisol made good progress in 1959—looks most promising for the future. In this case, the drop in price of plastisol resin to 26½¢ is claimed to have been largely responsible—puts the foam in a more competitive position with other foams. Some of its particular advantages are flame resistance and ease of molding. Upholstered public seating could be a natural for vinyl.

Unplasticized vinyl consumption in 1959 is estimated at about 20 million lb. for sheet and 17 or 18 for extrusions. Predictions on future growth are uncertain. Processing problems, such as corrosion of machine parts by hydrochloric and critical temperature range have been largely overcome. Resins have been tremendously improved to make processing easier and give better properties. Knowledge on how to extrude or mold unplasticized vinyl is now available to any processor. The great problem is to develop markets; and that takes time.

Unplasticized calendered sheet, made chiefly from vinyl chloride-acetate copolymer, grows a few million pound every year. Clear or colored sheet is used for lighting fixtures, spiral book binders, playing cards, and wall covering. In the last it is now facing competition from impact styrene. Unplasticized vinyl sheet is widely used for thermoformed signs. In blister packaging, a film of from 3 to 15 mils is gaining recognition because of its stability, barrier properties, and fast cycle time.

Thin unplasticized vinyl film has been widely used in Europe ever since the war for various tapes, packaging, etc., but has never attained prominence in the United States. One of the problems is to find a non-toxic stabilizer that will prevent breakdown of the material at 500° F., which is required in extrusion. Nevertheless, there is still a good possibility that such film will be produced in quantity lots in this country soon.

There was an 80% increase in

use of extruded rigid vinyl shapes and pipe in 1959 over 1958. The largest portion was pipe and tubing. Underwriters' approval has been obtained on rigid vinyl conduit for use underground or buried in concrete. Illinois was added to the list of places where the plumbing code now permits use of vinyl pipe for conducting potable water from the main to the house. The U. S. Navy is one of the best customers, continuing to use it for salt water conduction in their pipes aboard ship for wash-down after possible radiation.

Impact or Type II is still the most widely used compound for pipe; but normal impact (the unmodified type) is improving its position. Some users say its strength is adequate for most purposes and that it has better weathering, less linear expansion, and better chemical resistance.

However, the rate of growth for extruded shapes in 1959 was probably greater than that for pipe, tubing, and conduit. The most talked about item was window frames, but there were dozens of other odd shapes that went into use. It does not "seize" or "gall" and thus prevents sticking.

Some day rigid vinyl extrusions are expected to reach great markets in construction—sidings, gutters, flashing, and similar jobs. It is already moving into the roofing field and this may be the spark that sets it off in other applications. However, this development will take a long time—maybe late in the 1960's—but when it comes, vinyl chloride resin production will really take off.

An example of how vinyl chloride can "take off" when the right application appears is in floor coverings. At the beginning of this decade, there were only 10 to 15 million lb. used for flooring. It had been first exhibited in use at the Union Carbide building at the Chicago World's Fair in 1933. One thing after another had delayed its development until the late 1940's. It wasn't even reported in Tariff Commission reports until 1953, when 25 million lb. were listed. In 6 years' time it has grown by 132 million lb., to a total of 157 million lb., or more than 500%, and the bigger it gets the faster it grows. Practically all the

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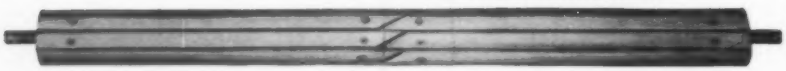
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major flooring producers now have a vinyl line—in 1950 there were only three or four.

There is some belief that all the resin used for flooring is not reported in that column—a few million pounds may be in "all other uses" as shown in the table on p. 97. There has always been a small discrepancy here, since plastisols used for coating the paper on felt backed flooring was partially reported in "paper treatment." Now all the plastisol used in this application is reported in "floor coverings." It was a thumping 20 million lb. in 1959, much higher than in 1958, since several companies have now entered the field once held almost entirely by Sandura. This is flooring in which treated paper is covered with clear vinyl and laminated to felt.

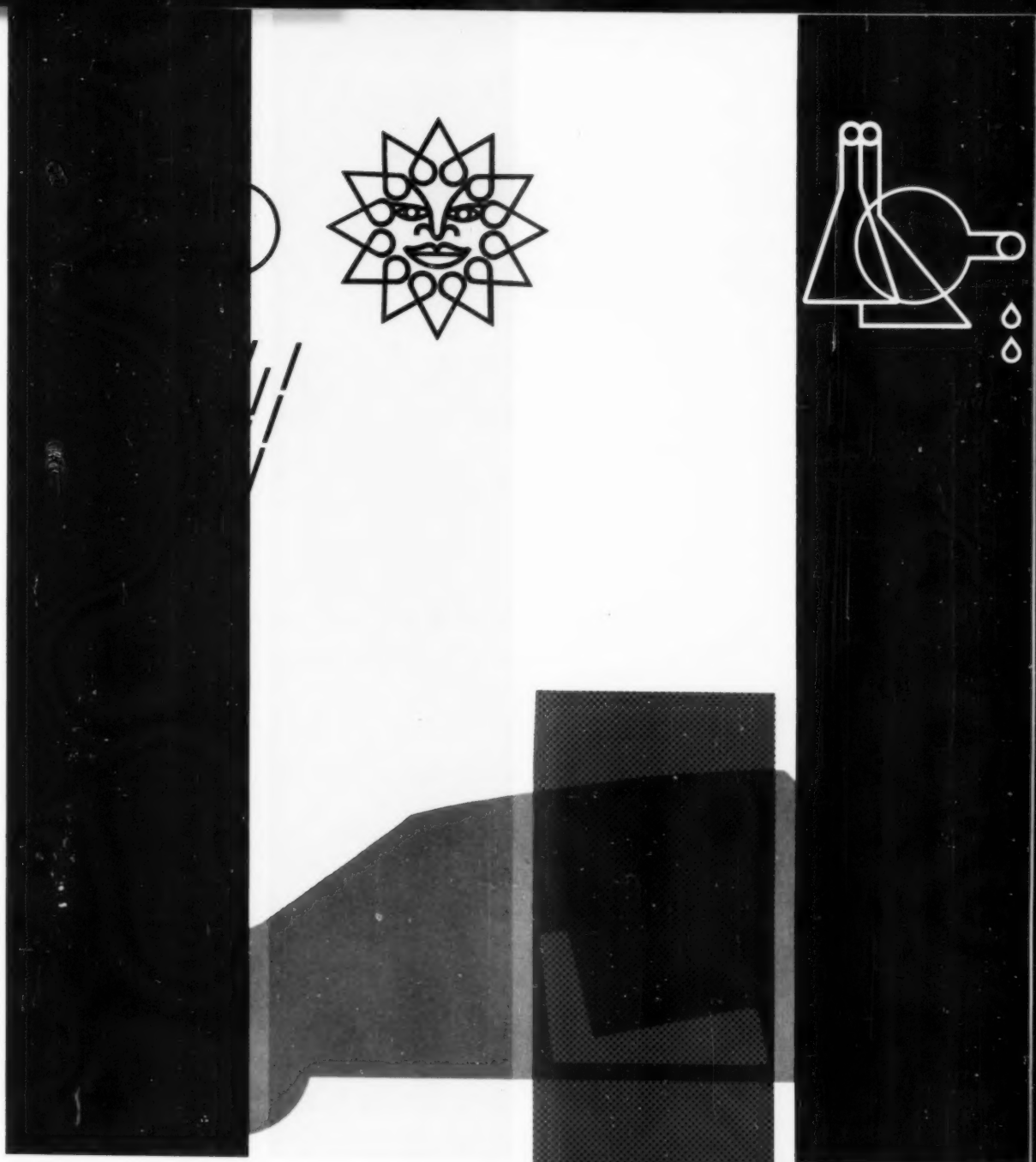
Vinyl-acetate and homogenous vinyl account for most of the resin used in floor coverings, with the former taking 48% of it. The formulation used is around 85% vinyl chloride and 13% acetate, but the percentage of resin used is generally under 20%, with fillers making up the balance. A newer type is a clear resin with the adhesive or a tinted color behind it, which gives a marbleized effect.

Molding and extrusion resin volume is now far above that used for calendering, unless floor covering is considered in the latter category. The table at the top of p. 98 gives details but opinion varies on this breakdown.

Wire coating is by far the largest outlet and, except possibly for profiles, is potentially the largest area of growth. A few months ago it was believed that the total amount of resin used would go over 100 million in 1959, but the vicissitudes of the copper industry slowed down production.

Phonograph records had a big year in 1959—from 38 to 43 million pounds. The resin generally used is an unplasticized vinyl-chloride acetate copolymer, but several vinyl producers entered the field this year with a straight PVC, which they assert can be blended with the copolymer. The threatened competition from polystyrene for the record business has not yet materialized, although PS is widely used for small records.

Of the 54 million lb. shown in



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the table on p. 98 for slush and elastomeric, the latter is thought to account for from 10 to 15 million pounds. Wiring devices eat up a good portion; handles for bicycles, lawnmowers, and luggage are sizable. There is also some footwear in this classification either injection or slush molded.

Extruded profiles include hundreds of items from belts to auto windlacing or welting to shoe welting to channeling that is used in new buildings and heavy concrete dam construction. This is the most disputable figure in the table. The automotive industry alone used miles of welting, accounts for a good part of growth in 1959.

The garden hose figures in this table are much higher than in past years, but that is *not* because there was an upsurge in hose. Only virgin first grade resin has been reported heretofore. This tabulation includes off-grade resin, but does not include scrap. There are around 300 million ft. of garden hose produced per year, and, before the advent of the small diameter hose, this was figured at 1 lb. of material for every 10 ft. of hose. The percentage of first grade resin should also be increasing, since the amount of transparent, small diameter hose on the market is constantly increasing.

Protective coating resins have not shown extensive growth over the last 5 years. But there is always the possibility that new types, which can be applied to all surfaces, will become commercial. A vinyl chloride-acrylic type copolymer latex is said to retain elongation over long periods over wood and to be heavily loaded with pigment for use over masonry. Chalking resistance can be controlled so that it may be used over a wide variety of substrates.

The protective coatings total also includes a good amount of plastisols used for dip coating. By far the largest volume in this classification is for can linings, mostly for beer.

Resin for paper and fabric treatment stays about the same from year to year as the market fluctuates in and out of various products. Coated decorative paper for shelves and housewares is the largest consumer. Another big market is in hygienic cellulose,

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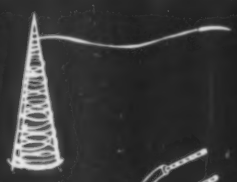
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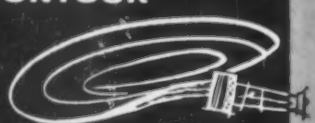


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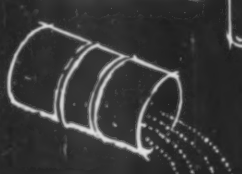




SHEETING

BLOW-MOLDING



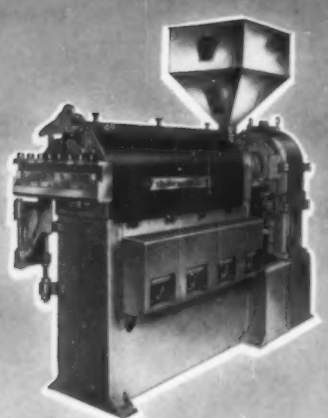


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where the resin is used as a binder. A growing market that has taken a long time to develop is in unwoven fabric with a vinyl chloride resin binder. Many other resins have also been used for this purpose, but polyvinyl chloride seems to be the favorite.

Vinyl chloride resin for film and sheeting took a record jump upward in 1959. An increase in automotive production was perhaps the principal reason, but there was a general increase all along the line.

Film, sheeting, and fabric treatment are now thoroughly mixed up, since calender-coated fabric is reported as sheeting in the government's report. MODERN PLASTICS has attempted to estimate this amount and put it back into fabric treatment as shown in the table on page 97. The sheeting figure of 87 million lb. thus contains no coated fabric, but it does contain around 20 million lb. of rigid sheeting. The 1958 figure of 74 million lb. included about 15 million lb. of rigid sheeting. The figure for plasticized vinyl sheeting (10 mils and over) in 1959 is 67 million lb., compared with 59 million lb. in 1958.

The fabric treatment figure of 70 million lb. includes an estimated 40 to 44 million lb. of resin for calender-coated fabric, around 25 million for spread-coating and 5 million for miscellaneous. The figure does not include the resin for film laminated to fabric, which is a rapidly growing enterprise. But the resin used is accounted for in the film figure at the top of the table.

The film business was particularly encouraging last year after a leveling off that had lasted for several years. Not only volume but also the price situation improved, with a fairly firm price all year and even a 2¢/lb. price rise to 52¢/lb. toward the end of 1959. In the last 5 years, price competition has been so vicious that even a 42¢-price has been reported on some occasions.

The increased volume of calendered vinyl in 1959 has revived interest in this segment of the vinyl industry. Two years ago the calenderers were depressed—feared that future growth was threatened. Used calenders were reported up for sale in various

plants. Now the reverse situation seems to be true.

The film figure of 86 million lb. includes an estimated amount of 4 or 5 million lb. of resin for cast film and several million more for extruded film. The latter is now available in a formulation that has reportedly received FDA sanction for use as a food wrapper. Clear, cast vinyl is now used for storm windows, glazing, and thermoforming where it is particularly used in blister packaging. Reynolds Metals entered the field last year with a vinyl cast from solvent PVC resin. The film has cling and shrink properties to compete with saran in the household wrap field. The firm has been making an organisol cast film used in finger bandages for several years.

The drapery and curtain field stays about level. There are more of them, but a big portion are only 2 mils thick, compared to thicker gages in earlier days.

Adhesive backed film is increasing from purely decorative uses to application as wall covering in small rooms. Closet accessories might have increased more except that thickness has frequently been dropped from 6 to 4 mils, and the quilted bags use only ¾-mil.

The shower curtain business was good in 1959. One estimator suggested 12 million pounds. A big volume was in 3-mil film for lower cost market; higher quality curtains now are mostly 6 mils.

Rainwear and baby pants were severely affected by imports of finished goods from Japan and Hong Kong. Some raincoat producers are reportedly buying finished items from foreign manufacturers and acting as distributors in this country. Domestic-made rainwear in opaque is generally 6 mils—transparent low-cost garments are 4 mils. Imports of this variety are reportedly as low as $7.50 a dozen, which would scarcely pay for the film alone in the United States.

Lamination and quilting is a mere guess—estimates vary from 13 to 24 million pound. They go into a variety of fields, including flooring and upholstery. There is a nylon scrim laminate with 3 or 4 layers of vinyl, which is used for outdoor covers, chairs, luggage, and beach umbrellas. An open weave fabric with laminated film has been growing in importance for 3 years. Non-woven fibers form another substrate.

Inflatables is another imponderable. It is impossible to separate those made of film from those made of sheet. The total amount of all compound used in inflatables may be 18 or 20 million pounds.

Great improvements have been made in film forming since the chaotic early 1950's. There is no longer a single, general-purpose film to be used for everything. Film is tailor-made for the job, just like resin. Resins, plasticizers, and stabilizers are all changed to meet specifications.

The film market is once more on the way up. It may not grow as fast as floor coverings or profile extrusions. But the industry expects a growth that will at least keep up with population trends and hopes for even more. Industrial uses are expected to lead this expansion.—**End**

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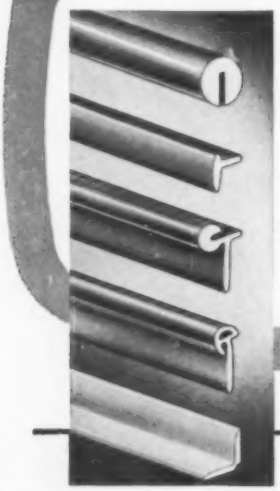
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PROGRESS IN PLASTICS

Polystyrene

(From pp. 100-104)

In the styrene end use precentage chart shown on page 100, it is obvious that refrigeration is the "big" item. It is believed to be around 100 million lb. in 1959, compared with slightly under 70 million in 1958. Sales for refrigeration held up remarkably well through October, and if 5 million refrigerators and 1½ million air conditioners were made in 1959, the total styrene used ought to be about 100 million pounds.

Somewhere between 30 and 40 million lb. of impact material is estimated for refrigerator door liners alone. Other uses for impact sheet are drip trays, doors for the freezer compartment, and shelves. But there is also considerable impact molding material used. A growing amount of PS is used in air conditioners, but its potential is probably less than 10 million.

An optimistic note that there may be a 100-million-lb. increase in refrigeration usage within a year or two is the development of a complete inner liner of impact styrene for the food section.

The small appliance industry is another good prospect. Poundage increased from around 10 million lb. in 1958 to perhaps 25 million in 1959, partly due to increasing use on television sets where housings and bezels are now in big volume. Small radio housings, especially portables, are another good item, and there is an increasing use in housings for small motorized appliances.

Packaging consumption has zoomed up from around 30 million lb. just a few years ago to close to 80 million lb. in 1959. If it continues to grow at present rates, packaging may soon become the largest outlet for polystyrene.

Polystyrene containers are everywhere and the amount used for closures is no small item either. Most of it is probably general purpose, but impact will probably overtake it. Europeans use far more general-purpose than impact for packages, but said packages don't have to take the banging around they receive in U.S. supermarkets.

Razor and razor blade boxes are an example of how one type

of container for a small but expendable item can consume millions of pounds of resin. Berry boxes is another. Impact-type containers for ice cream, cottage cheese, etc. are now common but still have a lot of room to grow. It is almost inconceivable to think of a packaging volume in 1959 greater than refrigeration use in 1958, but that's what the researchers say. Polystyrene film is involved in this field too, especially as container covers and windows for envelopes, but the total film volume so far involved is less than 10 million pounds. There are claims for 80 or 90 million lb. if the film can be sold in the bag and flat wrapping market.

Sales managers raise their hands in hopelessness when asked to estimate the amount of styrene used in toys. The reason is that so many toys are molded from off-grade resin obtained from reprocessors. Both good and poor toys are made from this product, some of which is upgraded with a blend of first grade virgin material. There is often nothing wrong with off-grade except color, and it has no heat history to weaken its properties. It is fairly well established that at least 30% of the material used for ordinary toys is first grade.

The hobby kit market uses between 15 and 20 million lb. of resin and from 60 to 70% of that resin is first grade—all moving parts are impact resins. Such products generally sell in the $10 and over range. A miniature organ sells for $20.

The amount of virgin resin, including off-grade, for toys, was roughly estimated at from 50 to 55 million in 1959, compared to around 35 in 1958.

In the housewares field producers are frank to admit that polyolefins have and will continue to take a good cut of the market, but polystyrene is now holding, and probably will continue to hold, a reasonable share of the volume for the foreseeable future. Impact materials, hard and glossy surfaces, and ease of molding are influential factors in keeping polystyrene alive in this field.

A new development in '59 was the introduction of a set of dinnerware molded from general-purpose polystyrene with a whorl design to obliterate the effect of scratching. It is a step above picnic ware in price and not intended to compete with the more costly plastics-type dinnerware. There are also millions of lb. consumed in tiny spoons, forks, etc., used as throw-away items with various kinds of foods. If the items displayed at the last Atlantic City housewares show, take hold in 1960, there should be another sizable increase from the 30 to 35 million in 1959 and the 20 to 25 million in 1958.

And there is always the possibility of a new product sweeping the market, such as the decorated clear and transparent colored water tumblers, which were introduced just two years ago.

Wall tile is not showing any progress. In fact, it has declined from the volume used 4 or 5 years ago and was around 30 million lb. for each of the last 2 years.

The peak for wall tile was in 1955, when 140 million sq. ft. were produced. The present level is 70 to 75 million. There has been a noticeable drop for its use in new homes, although some of the big projects and motels use it extensively in bathrooms and kitchens. The general contractor can get more money from his banker when the plans call for ceramic tile, so he doesn't encourage the use of plastics. However, the do-it-yourselfer is still using a lot.

The wall tile market has been sadly beset by price wars and a consequent deterioration in quality. Each manufacturer blamed the other for his troubles. Competition from a low cost thin ceramic with mastic applied has also been tough. But most of the distributors and retailers have a good attitude toward polystyrene tile and would welcome a sound promotional and selling campaign by their suppliers instead of the constant bickering.

A pure guess on the amount of resin used in novelties would be 15 million in 1959 and 10 million in 1958. Here again there is a large quantity of off-grade material in use, and this estimate is certainly open to challenge.

The miscellaneous figure of over 175 million lb. is the catch-all for polystyrene, but any reader



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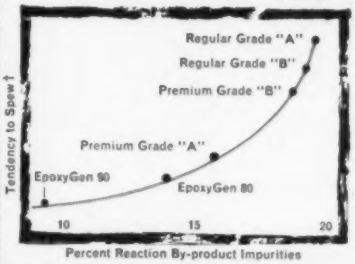
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can see that it is the largest on the list. Nearly all the items consume less than 10 million lb. a year—some of them less than a million; but any supplier in the business would like to have the whole kaboodle.

There are three products in this list that were in the neighborhood of 10 million lb. in 1959: lighting fixtures may have been 12 or 13 million. Toilet seats are close to the 9- or 10-million mark, and toiletries, brush backs, mirrors, and combs are estimated to have moved from 8 million in 1958 to perhaps 10 in 1959. Polystyrene records consumed somewhere between 7 to 10 million pounds. The amount used for monofilaments in brushes is another secret. Mechanical pens and pencils are using 6 or 7 million lb., and a good portion of it is high grade, transparent, light resistant material. Soil pipe uses great quantities of off-grade material. Molded furniture drawers are still in infancy, with big volume expected at a later date.

Resin used for polystyrene foam of either the bead or fabricated type is *not* included in the molding resin classification in 1959, although the bead type was formerly listed in that category. No production figures are presently available, but all types of styrene foam made good progress in 1959. The greatest use has been in construction of low-temperature storage facilities where foam has practically replaced cork. It is also widely used for perimeter insulation under houses that have no basement. An application that grew from almost nothing in early 1958 to over 100,000 sq. ft. a month in early 1959 and by now may have doubled, is for insulation on masonry walls. It is particularly effective on concrete, which passes heat, water, and water vapor, while the foam stops all three. Among the newer developments is foam with a paper skin to be used on roofs—the paper protects it from tar or asphalt. As a packaging material, its cushioning properties are ideal for shipment of fragile items. Drinking cups of foamed styrene that insulate against heat are in use on airplanes. A laminated paper-foam cup for use in vending machines is about to make its debut. Another development is a paperboard-styrene foam laminate that has great possibilities for moving in on the corrugated fiber board container field.

A Dow executive estimates that about 105 million cubic ft. of styrene foam will be used in 1965, although the total may have to be revised downward if some of the other foams develop. This total would amount to 200 million pounds of resin.

Styrene copolymers grew from an estimated 40 million lb. in 1958 to somewhere between 50 and 60 million lb. in 1959, depending upon whether or not the filler used in certain types of ABS materials is counted. The price of these materials is far above that of general-purpose and normal-impact-polystyrene.

Acrylonitrile-styrene is thought to be around the 20 million lb. level. Its chemical resistance and clarity properties have sales appeal. A drive to establish it in low-cost dinnerware or occasional-ware may be initiated soon, but when tried once before the project failed to get off the ground. A lower price might raise volume by a considerable amount. Both the raw materials used, styrene monomer and acrylonitrile, have been reduced materially in price since ABS was first introduced.

Here is a list of some of the articles now produced from styrene-acrylonitrile copolymers:

Packaging; occasional ware; extruded film for garden cold or hot house frames; tumblers; monofilaments for scour pads; brush blocks for hair brushes; appliances (crisper covers, shelves, bleach dispenser, agitator or impeller shaft of washers); inside piece of telephone voice box; thermo-wall mugs, canister sets, butter dishes; batteries, from transistors to big wet cells; and pen barrels.

All ABS plastics are now moving into automotive uses, such as center post covers, air conditioning ducts, arm rests, instrument clusters, and truck trailer lines.

Cycolac (Marbon Chemical Div., Borg-Warner) had a big boost last year as it moved in to become a principal material in the telephone hand set business, partly

because of its resistance to stain, particularly lip-stick. Volume could have been as high as 12 million lb. in 1959.

Kralastic, the other ABS copolymer, is used primarily in pipe and sheeting. A large part of it is captive, since Naugatuck Chemical produces the resin and U. S. Rubber does a good portion of processing it into sheet and pipe. Neither company releases information on how much is made or processed. B. F. Goodrich Chemical Co. moved quietly into the Kralastic business a year and a half ago, so there are now two resin sources. A pipe maker's guess on the amount of ABS material used in pipe in 1959 was from 8 to 10 million pounds.

Another copolymer is Dow's styrene-methacrylate resin, called Zerlon, which sells at 49¢/lb. or 6¢ under methacrylate molding material. Use tests are still going on to determine if its weathering properties will make it adequate for automotive uses. It is expected to move into many indoor applications such as point-of-purchase signs and medallions.

The coatings total is considerably more than in 1958, since both latexes for paint and paper-textile coatings showed considerable increase in 1959. The competition from vinyl acetate and acrylic paint resins hasn't stopped styrene-butadiene paint resin from growing, but it has probably cut into the rate of growth.

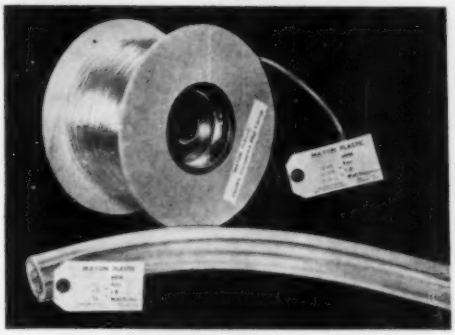
The growth of coating resin for paper is now proceeding at an accelerated rate and accounts for around 50 million lb. of the 130-million-lb. total. It is being used on paper to replace casein or starch to give a better printing surface, and helps keep the paper flat while being printed. It is thought to have replaced from 10 to 20% of the casein binder. Styrene latex is particularly suitable for paper board, since it is claimed that it gives a more even surface, better gloss, and accepts ink better than a starch sized surface. Resin producers hope to obtain 100% of the printed paper board market, but a smaller portion of the thin paper market because the latex gives a stiffer drape than acceptable in magazine and similar type papers—**End**

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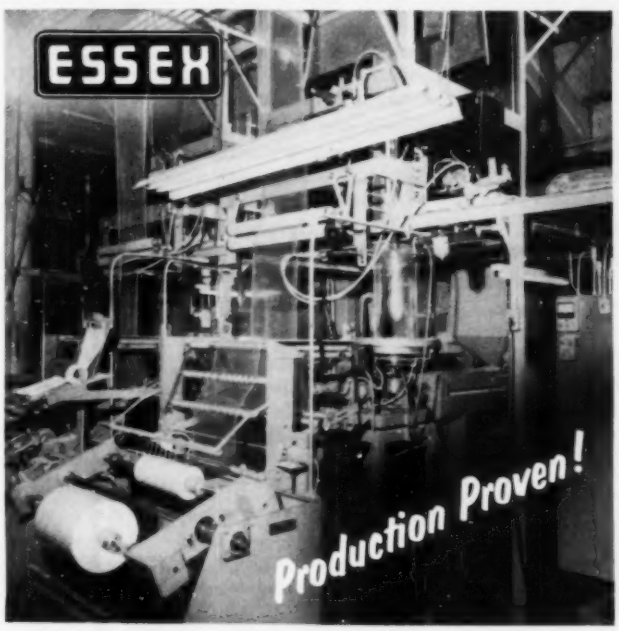
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Cellulosics

(From pp. 104-106)

Sheets over 3 mil are nearly all extruded, with five companies reporting. One of them reports continuous lengths in this classification. They go all the way up to ¼ in. in thickness.

Here, too, growth has been mostly in vacuum forming. A considerable amount of this thicker sheet material is used in laminated eye glass frames. Windshields and sequins are other outlets. Butyrate sheet for signs is another sizable item. A 10% growth in sheets, rods, and tubes is expected in 1960.

The table on p. 104 indicates that molding and extrusion material remained relatively stable at from 90 to 93 million lb. from 1955 through 1958.

The increase in 1959 must have come mostly from butyrate, which is now well over half the combined acetate-butyrate production. There are several million pounds of extrusion material used for sheet that is later vacuum formed into a variety of end product.

The total also includes a good quantity of propionate for colored telephone hand sets, though a portion of that market has been lost. The principle reason given for the loss of part of the telephone market of ABS material is that the cellulosics stain from lipstick and perspiration. The sad part of the situation is that soap and water will easily remove the lipstick. The ladies' shoe heel market is not entirely lost, and there is even a pretty good possibility that part of this market will be recovered when spike heels give way to another more substantial underpinning for women's feet.

Butyrate pipe, tubing, and extruded shapes account probably for over 2 million pounds. Tubing, as distinguished from pipe, includes non-standard size pipe, tooth brush packaging tubes, transparent conveyor lines, rectangular tubes for necktie and suspender packages, and similar products. Extruded shapes of all sorts for other purposes are in large volume. Butyrate is particularly useful in these extruded forms because of its clarity and toughness.—**End**

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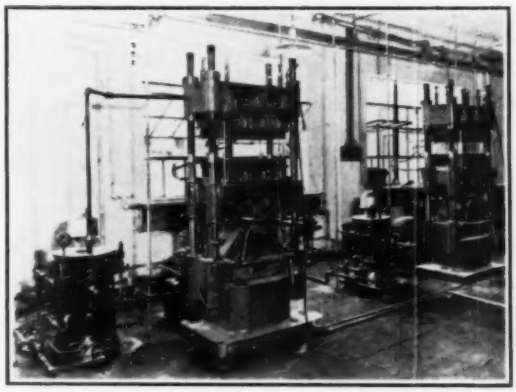
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Delrin

(From pp. 108-109)

If Delrin declines to the methacrylate price level, volume will not be so mountainous, unless its replacement of metal parts grows to gigantic proportions. History indicates that all plastics in the 40- to 70¢-range are difficult to sell in large volume. But if Delrin ever goes under 40¢, it could challenge any plastic for volume use in molding. This, of course, is speculation that Du Pont would never approve . . . but the plastics industry is chock full of rumors that often come true.

The basis for belief that Delrin will eventually be low cost is the price of formaldehyde, the raw material from which it is produced. Pure formaldehyde is around 10¢ to 11¢/lb.; is generally sold in a 37% water solution at 3¾ cents. Du Pont has made no comment on the processing cost, but chemists say that the business of obtaining a completely pure formaldehyde is most difficult and costly. Researchers have been trying to polymerize formaldehyde for many years—nearly everyone was agog when Du Pont said it had found the answer. Thus a cheap raw material does not necessarily indicate a low cost finished product. But the belief still persists.

Delrin is an acetal resin, has a heat resistance of 180° F. (continuous) and up to 300° F. intermittent. It melts at around 300 to 400° F.—the nylon melting point is about 100° higher. It is not affected by solvents but is not immune to certain acids. It has a very low water pick-up, not quite as low as Penton or polycarbonates, but less than nylon.

Like all new plastics, molders must learn how to use Delrin and follow instructions. It burns with a terrifically hot fire if exposed too long to flame, and requires tricky handling at the point where it goes into a gaseous state.

Extrusion grade material will also soon be available in quantity for use in rods and tubes. Blow molding is also possible.

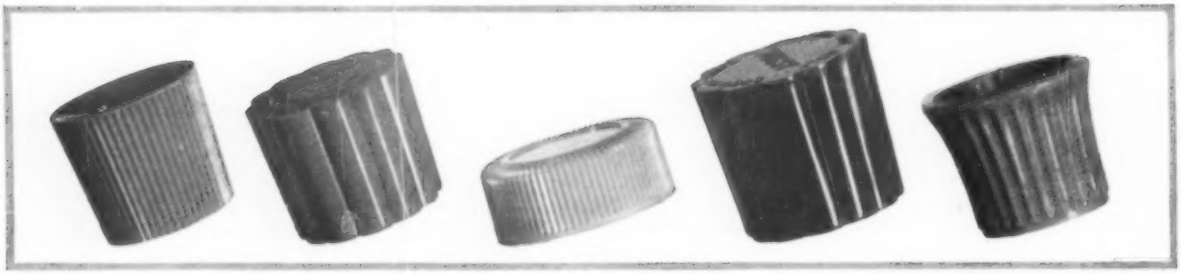
A number of items molded from Delrin are shown on pages 99-101 of the November MODERN PLASTICS. It is being pushed primarily as a replacement for zinc die cast items, aluminum, and brass. A fishing reel formerly in aluminum, an internal valve for a hot and cold water faucet that was in brass are examples. A molded instrument cluster for automobiles is another example. Delrin overlaps with nylon in some cases such as bushings and gears, but has higher stiffness, is not affected by humidity, and will soon cost less.

Even at present prices Delrin is competitive with zinc die casting. A cubic inch of Delrin costs 4.88¢, against 3.3¢ for zinc. But there is no finishing necessary with Delrin. Fabricating costs and lack of color in zinc are factors in Delrin's favor—at 65¢ lb. Delrin would equal zinc even on weight for weight basis only. Brass costs about 7¼¢ per cu. inch.

The year 1960 will be an interesting one for Delrin as molders become more familiar with it and find markets where it can be used to advantage.—**End**

Boxes designed by Avon, molded by Garmold, Inc.

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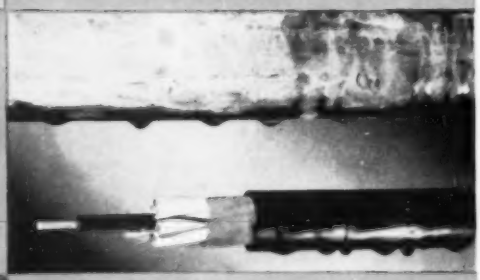


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AUTOMATIC EDGE GUIDE. Illustrated bulletin sheet describes an automatic edge guide controlled by photocell or hydraulic or air web guide, and/or constant-tension control. John Dusenbery Co., Inc. (A-002)

EXTRUDERS. Illustrated 8-page brochure describes a line of extruders which includes models of 2½, 3½, 4½ 6, 8½, 10 and 12 inches. L/D ratios of these models descend from 24:1 for smallest to 14:1 for largest. John Royle & Sons. (A-003)

MOLD WIPER. Illustrated 4-page brochure describes an automatic mold wiper which synchronizes with machine cycles, preventing the machine from closing on it, and which is adaptable to all injection molding machines. Bermer Tool & Die, Inc. (A-004)

WHITE PIGMENTS. Illustrated 56-page booklet describes a group of titanium white pigments and discusses their fundamental and technical properties and their uses in plastics, etc. Titanium Pigment Corp. (A-005)

AIR-HYDRAULIC PRESSURE BOOSTER. Illustrated 24-page booklet describes and gives specifications for a line of boosters which convert shop air to much higher hydraulic pressures, for plastic laminating, etc. Miller Fluid Power Div. of Flick-Reedy Corp. (A-006)

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DIELECTRIC HEATERS. Illustrated 4-page brochure describes a line of dielectric heaters for heating, drying, baking or curing non-conducting materials. Allis-Chalmers. (A-009)

CUSTOM MOLDING. Illustrated 12-page booklet discusses the facilities and technical and engineering services of a custom molder located in New York City. Gilbert Mfg. Co., Inc. (A-010)

OVENS. Illustrated catalog describes a line of ovens including drawer, walk-in, cabinet and gravity types, burn-off ovens, furnaces, sterilizers and food baking and processing equipment. Prices. Despatch Oven Co. (A-011)

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METER-MIXER. Illustrated 4-page brochure describes an automatic "shot" meter-mixer for two-part compounds and adhesives in intermittent or production line operation. Pyles Industries, Inc. (A-013)

FLOW INDICATOR. Illustrated data sheet describes and gives mechanical drawings of a low cost flow indicator and alarm, available in various models, especially suited for purge type service. Brooks Rotameter Co. (A-014)

ANTI-STATIC AGENT. 4-page brochure describes an anti-static agent said to have long-lasting effect with all hard-surfaced plastics, both thermoplastic and thermoset. Merix Chemical Co. (A-015)

TESTING EQUIPMENT. Folder describes a line of non-destructive testing equipment of the following types: ultrasonic—immersion, contact; radiographic—X-ray, gamma; thermometric—paints, crayons. Curtiss-Wright Corp., Princeton Div. (A-016)

PRE-COMPRESSED MOLDING. Illustrated 16-page brochure describes the pre-compressed molding method, with diagramatic drawings, gives case histories and discusses its advantages, which include improved physical properties and quality of product and reduced finishing costs. W. R. Grace & Co. (A-017)

HYDRAULIC PRESSES. Illustrated 8-page brochure describes a line of air-powered hydraulic presses for laboratory test work, laminating, compacting, etc., in capacities of 30, 50, 75 or 100 tons. Elmes Engineering Div., American Steel Foundries. (A-018)

AUTOMATIC EDGE GUIDE. Illustrated 4-page brochure describes an automatic edge guide using low pressure sensing air. Sensitivity is instantly adjustable from very fine to relatively coarse. Degree of misalignment is met by appropriate speed of correction. Web Controls Corp. (A-019)

RODS, SHEETS, TUBES, FILM. 64-page catalog lists and gives specifications for rods, sheets, tubes and film of Plexiglas, Vinylite, polystyrene, polyethylene, Teflon, Nylon, acetate, Mylar, Kel-F and others available from stock. Prices. Cadillac Plastic & Chemical Co. (A-020)

MOLDING PRESS. Two bulletin sheets describe a 200 ton transfer and compression molding press with opening adjustable from 38 to 50 in., platen 30 x 24 in., and a 314 ton press of strain plate construction, 16 in. stroke, platen 24 x 24 in. Erie Foundry Co. (A-021)

PLASTICIZERS. 30-page booklet describes two octyl epoxy stearates, gives their physical properties and the properties of compounds containing each. Suggests applications and discusses their effects in plastisols, organosols and neoprene rubbers. Charts, tables. Argus Chemical Corp. (A-022)

PLASTIC SOAP GRANULATOR. Illustrated 4-page brochure describes a rotary knife plastics granulator for reducing thermoplastic scrap. Two models, with capacities of 100 to 200 and 200 to 400 lbs. per hour. American Pulverizer Co. (A-023)

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Nylon

(From pp. 107-108)

stated its production will be for sale rather than for captive use.

The various categories in which molded and extruded nylon are used are: industrial machinery, automotive, appliances, hardware and plumbing, wire and cable, and consumer uses. Industrial machinery is the largest, where gears, bearings, bushings, and other movable parts are employed. This group even increased in 1958 when most others were down. The appliance category increased in 1959. Nylon use in gears, bearings, door locks for refrigerators, and valves in washing machines is growing steadily. One estimator said appliances would consume at least 3.5 million lb. of nylon by 1963.

Automotive uses continue to increase in number and poundage. Dome lights and gears started it off. Use is now being made of tubing for spark control—it is less costly than metal and requires no fittings. Fuel lines are a possibility, as are lube lines in cars which use them. Nylon fan blades are used in the French Citroen.

Consumer items were the only other classification which did not decline in 1958, but there has been no particular increase in 1959 despite efforts to promote them. Growing use of nylon knife handles is perhaps one exception. Cores in golf balls is also a growing application. Roller skates still use nylon rollers, but the platform for the foot has succumbed to lower-cost impact styrene.

The new Remington .22 caliber, 14-shot rifle could be called a consumer item and is apparently well on the way toward mass production. Everything in this rifle except the barrel, bolt, and firing pin is in nylon. Each rifle requires about 20 ounces. There are 12 subsidiary parts in addition to the stock. The rifle producer says nylon offers an ideal combination of properties for the job, which demands perfect alignment of the moving parts or inserts.

A redesigned nylon garden hose coupling has also made its debut. It fits readily on vinyl hose. A customer can go into a store, buy any length of hose he wants, and

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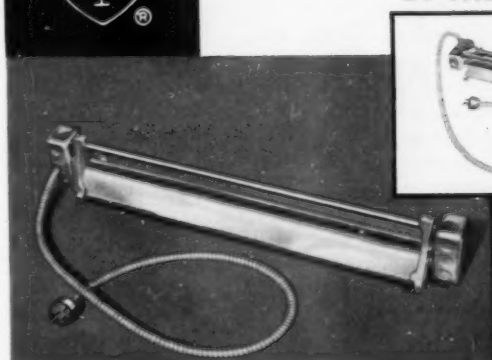
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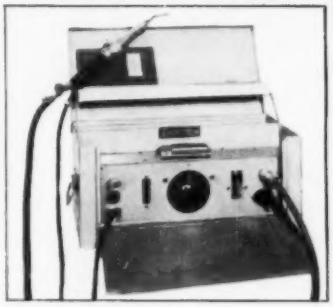


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fit it to the coupling right there.

Some interest has been shown in a transparent nylon that can be injection molded or blow molded and remains clear at thicknesses up to 40 or 50 mils, but there are no commercial applications as yet.

Nylon for wire coating is also an important outlet. The jacketing, so well known for use over Army assault wire, is gaining in commercial use but runs into code trouble now and then. The purpose of the tough jacketing is to provide protection and makes possible the use of a thinner insulation material. Nylon wire coating also has U.L. approval for use in gas stations.

Producers of nylon are still interested in finding markets for extruded film and sheeting. Because of its strength and clarity the film is suggested particularly for oily or greasy products but has not yet moved into the field.

Extruded sheet looks promising. Before the end of this year it is likely to find use in transmission or conveyor belts where it is employed as a core over which rubber or some other material is coated. The nylon gives extra strength and wearing qualities. Molded nylon plates on conveyor belts have been in use for several years—give long wear and don't give off tiny metal splinters that are a nuisance in many conveying systems. It is especially appropriate for conveying bottles.

The price of general purpose nylon remained at $1.18/lb. throughout the year. In England it is less than $1 a pound. Customers are constantly speculating on the chance of a price reduction due to the competitive situation, the theory that caprolactam is lower cost than raw materials for nylon-6/6, and the imminent competition with Delrin in many applications. But so far there has been no sign of a price break since the drop from $1.33 in 1957.

Like most other plastics, nylon has now reached the stage where a long line of formulations is available to suit a variety of needs. The material has a heat distortion point of from 350 to 370° F. at 66 p.s.i., depending upon the formulation, but drops down into the 160 or 167° area with a load of 264 p.s.i. At the low load, it is the highest of the more common thermoplastics.

A purchaser of nylon material may choose from formulations according to his need for particular properties. If he wishes more specific properties than those in general purpose, he may obtain one tailored for high temperature service life or one for maximum durability at high load, such as gears. Then there are those tailored for extrusion that will give unusual toughness and fatigue resistance or a higher viscosity for heavy cross-sections or for profiles that require low drawdowns. Still another may emphasize a greater combination of flexibility and toughness such as may be required in tubing or wire jacketing. Nylon itself comes in various forms as noted, but not as varied as products made from it. Where can you find a material that runs from combs to ship propellers to ladies' stockings?—**End**

Phenolics

(From pp. 109-111)

Readers should note that the 218-million-lb. figure given for molding powder in the table on p. 109 is a production rather than a sales figure. The sales figure as given by the Tariff Commission, when all reports are in for the year, will probably be around 208 million; but the entire phenolics industry, including laminating, insulation, etc., is so full of "captive" operation that a production figure seems to give a more realistic picture than a consumption total.

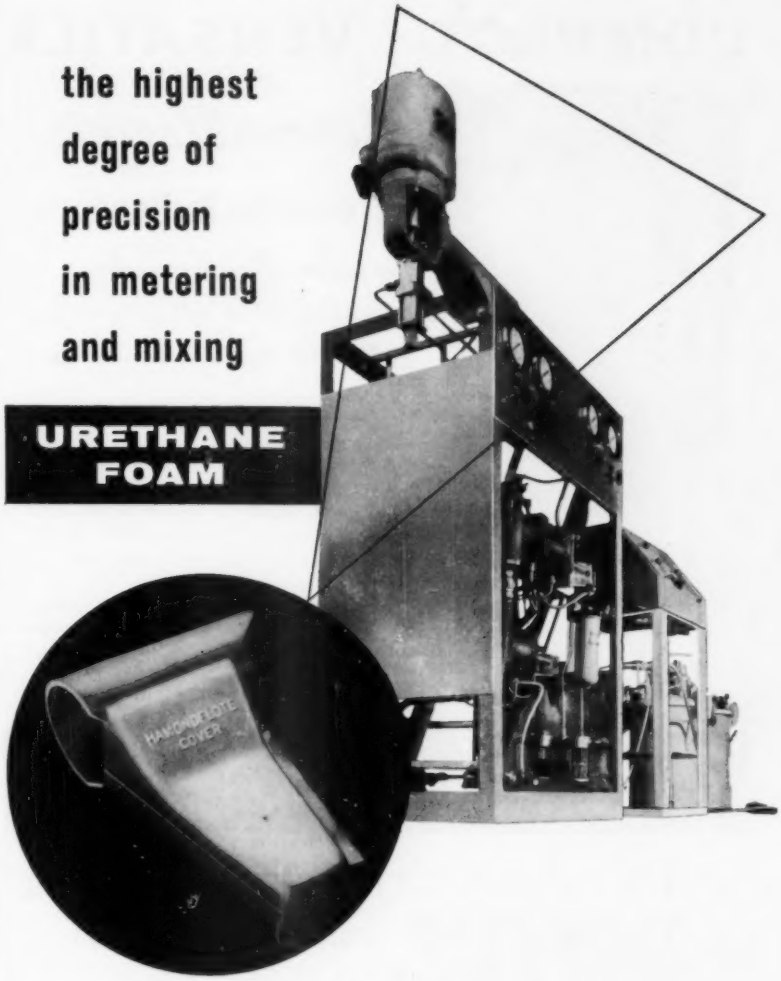
Captive plants (those that make and use their own resin) in the phenolic industry do not report what they use themselves as a sale, and, consequently, the production figure is closer to actual consumption than is the sales figure. There are a few who make and consume their own resin that don't report at all—this is even more true in other categories than in molding powder, so the total consumption of resin is higher than reported here. However, this situation has existed for many years and the Tariff Commission figures are a good indicator of trends even though the final report may be short a few million lb. which were actually consumed by the industry.

The chart on p. 110 gives an idea of the violent ups and downs in the phenolic molding industry ever since the war. In 1959, production rolled along at a fairly level rate of 16 to 18 million lb. a month until a tail-off at the end of the year, probably caused by the steel strike. Monthly figures are about the same as in the previous banner year of 1955. There is capacity in the industry by both producers and molders to handle a much larger quantity but when operating at a monthly average of 16 million lb., there is not much complaint by material makers.

Some phenolic producers are slightly worried lest molders are carrying extra large inventories of both molding material and finished parts or that users of those parts may have unwieldy inventories on hand, with no indication of when a tightening of this over-inventory may affect sales, but when it does come, the

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decline is expected to be only temporary. There is as yet no indication that 1960 will show a decline; but a dip in several months may be expected and this will probably be followed by another upsurge to bring the 1960's total at least up to or possibly above 1959 figures.

The largest growth in 1959 among end products was in electrical apparatus including wire devices. This combined application probably accounts for around one-half of the total phenolic poundage for the year.

Luckily for the phenolics this electrical industry continues to grow at an increasing rate. As long as utility companies keep expanding and supply more electric current, there will be demand for phenolic parts to help handle it. Some of these parts, such as panel boards and switch breakers, are extraordinarily large pieces. This looks to be a residual phenolic market for the foreseeable future because there is no other low-cost material to equal it in heat resistance and electrical stability properties.

Wiring devices are a big part of the electrical market—more than a third—and so far phenolic has resisted competition from molded vinyl and urea. The latter two have built good-size markets in this field, but phenolic still continues to lead the pack by a big margin.

There has been some deterioration in the phenolic closure market over the years from the invasion into this field by thermoplastics and urea. In the liquor, cosmetic, and pharmaceutical field, phenolics are still dominant with losses spotted here and there in the last two. The low-cost (17½¢) urea material is being plugged strenuously for these markets, and polyethylene for snap caps is now in common usage. It is probable that phenolic will always have a share of the market and that its losses to competition will be offset by increasing over-all use of closures as population grows. Amount used in 1959 is guessed at from 20 to 25 million pounds.

Use of phenolic in telephones has declined from a peak of 7 or 8 million lb. in 1956 to maybe 6

million or less in 1959. Telephone bases and hand sets are now being molded primarily in colored thermoplastics, but there still are many phenolic parts on the inside of a telephone, and the growth of junction boxes used for multiple phone connections and housed in phenolic will continue to create additional uses for phenolic in the telephone area.

Phenolic molding powder is now in charge of the agitator business in washing machines of all types. Aluminum agitators are claimed to be pitted by alkalies (soap and detergents) and also require costly machinery for fabrication. Agitators in the automatics are smaller than those in wringer-type machines, but there are more of them. There was some fear that manufacturers had stored up too many agitators in late 1959 and would, consequently, let down on their orders, but it was still a big year, with 13 million lb. of phenolic or more required for this application. This looks like a big market for years to come, but there is always a chance that washing machines made without agitators will become dominant at some future time.

Automotive moldings required more phenolic in 1959 than '58 simply because there were more cars, although there are only a few applications, such as the distributor cap. Perhaps 12 million lb. were used in 1959 as against 10 in 1958.

Vacuum tubes together with radio and TV condensers, resistors, and similar electronic parts used close to 10 million lb. in 1959—a figure that has been fairly stable for several years.

Camera parts that once required around 7 or 8 million lb. of phenolic a year have surrendered a part of the market to polystyrene material.

There are many miscellaneous items such as caster wheels, textile machinery parts, office equipment, toilet seats, and such that continue in fairly large volume. New uses in the missile and atomic energy programs come along every now and then.

Producers believe that the phenolic molding industry is now pretty well shaken down. Phenolics are generally used only where their low cost and specific properties fit a job better than any other material—consequently they are expected to lose volume only in a few applications. This would seem to smooth out the extreme ups and downs from year to year in the chart shown on page 110.

But if this is true, then who can explain the tremendous increase in 1959 over 1958? All general business was good and phenolics rode along on the crest but it seems incredible to believe that general prosperity alone could be responsible for such a large increase. It has often been said that only a screw-ball can understand the happenings in plastics and certainly only a wizard can predict the path of growth for phenolics. The moral of this story is very simple: "Don't ever sell phenolics short."

Laminating resins too had a nice increase in 1959. Note again that the 80 million represents production rather than sales, since this branch of the industry contains many firms who make and use much of their own resin. It is also probable that several companies don't report their consumption to the government—one producer estimates that the unreported resin in this category may amount to 20% of the government's figure.

A noticeable feature of the laminating resin totals in the table on p. 109 is the gradually increasing ratio of resin for decorative to that for industrial laminates. One resin producer even goes above the 80-million-lb. figure in the table on p. 109, and estimates that resin for decoratives in 1959 would be 45 million in contrast to 38 million lb. for industrial laminates.

His estimate for 1958 was 39 for decorative and 34 for industrials. He predicts that the figures will be 63 million for decoratives and 45 for industrials in the late 1960's. Obviously, he is much more optimistic about the future for decoratives than for industrials. There are some observers who believe that industrial laminates will even decline as competition from other materials for the same aplications becomes stronger.

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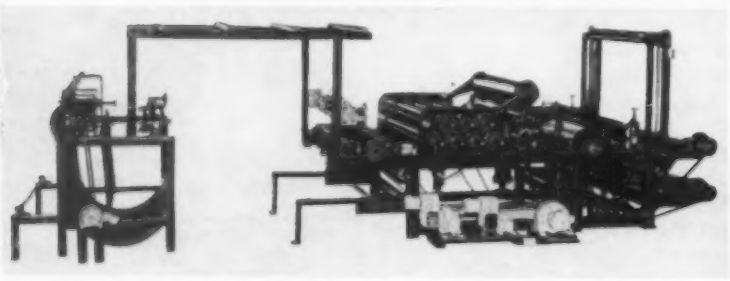


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laminating industry, supported by users of their material, who contend that a lower cost industrial laminate must become more generally used in order to fight off competition. Of course, its properties would not be as good, but they maintain that it is not always necessary to have such outstanding properties as now used—many applications could be adequately served with a laminate of lesser properties is their contention.

However, industrial laminates are no dead issue—they will be in at least a 30- to 45-million-lb. volume for years to come, according to generally accepted belief. Their comparatively new uses in such applications as missiles and printed circuits will help. A resin producer estimates that 7 to 8 million lb. of resin is now used in laminates for printed circuits. It is expected that use of printed circuits will double, or perhaps even triple, in the not too distant future as automation, miniaturization, and electronics technology improve, but the amount of laminate used for each circuit is generally tiny.

Decorative laminates have shown steady growth ever since they were introduced. The amount of phenolic resin used in the core is in greater volume than the melamine used in the overlay. Use of these laminates has expanded from kitchen sinks and cabinet tops to furniture to wall covering. Hotels in particular seem to favor decorative laminates for room furnishings of various types, including case goods.

There is lots of competition in the offing from other plastics and other materials, but laminators think they will be able to hold their own because of superior performance regardless of the higher initial cost for most installations.

Abrasive and friction material resins in 1959 ran well ahead of 1958, but not over the banner years of '55 to '57, because they are dependent on production in the automotive and metal working industries. Here is a part of the phenolic industry that is one of its oldest segments but today its progress is determined largely by what happens in the automotive industry. This is said to be one of the more profitable sections of the

phenolic liquid resin industry, with resins selling at around 35 to 40¢/lb. However, there is tremendous competition among the various producers for the amount of business available, and apparently growth is limited by the size of the user industries.

Thermal insulation, which includes the resin used for bonding fibrous glass and mineral wool insulation used in construction, refrigeration, etc., showed a big increase in 1959 over 1958, but not so much over the more prosperous 1955 to 1957 era.

The drop in 1958 was probably due to a decline in the construction industry. This is a business of either feast or famine, and the profit margin is extremely shallow —various producers have gone out of business and others have become captive. This 24½¢ resin material seems to encourage captive operation; and if the producer can't make it in large quantities close to the site where it is used, he is going to have trouble making a profit.

Resin for plywood continues to grow because use of plywood continues to attract more customers. This is another situation where there may be several million lb. of unreported resin, since there is so much captive operation, especially since resin production near the site of use is a distinct advantage. The resin is low-cost at around 26¢ on a solid basis and generally requires volume production by anyone not in the plywood business in order to return a profit. An encouraging development is that after many years of hesitation the soft wood plywood industry now seems definitely on the way to supersede such things as soybean adhesive with more phenolic resin to upgrade interior plywood. If this trend continues, the industry may use phenolic in 50% of its product instead of the currently consumed 25 percent.

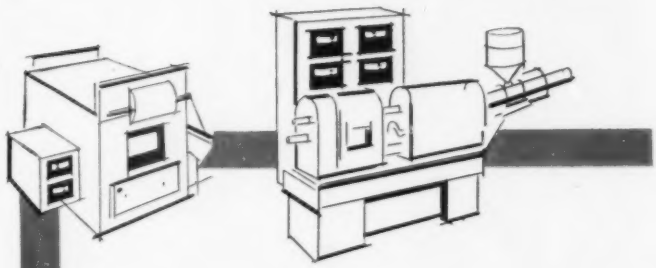
The categories of "all other bonding resins" and "resins for all other uses" are probably intermixed in the total figures in the table on p. 109. These categories include so many items, exports among them, that there is no way to separate them. Included are the much-talked about shell-molding resins used in foundries. These

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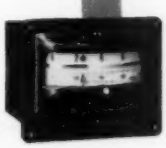


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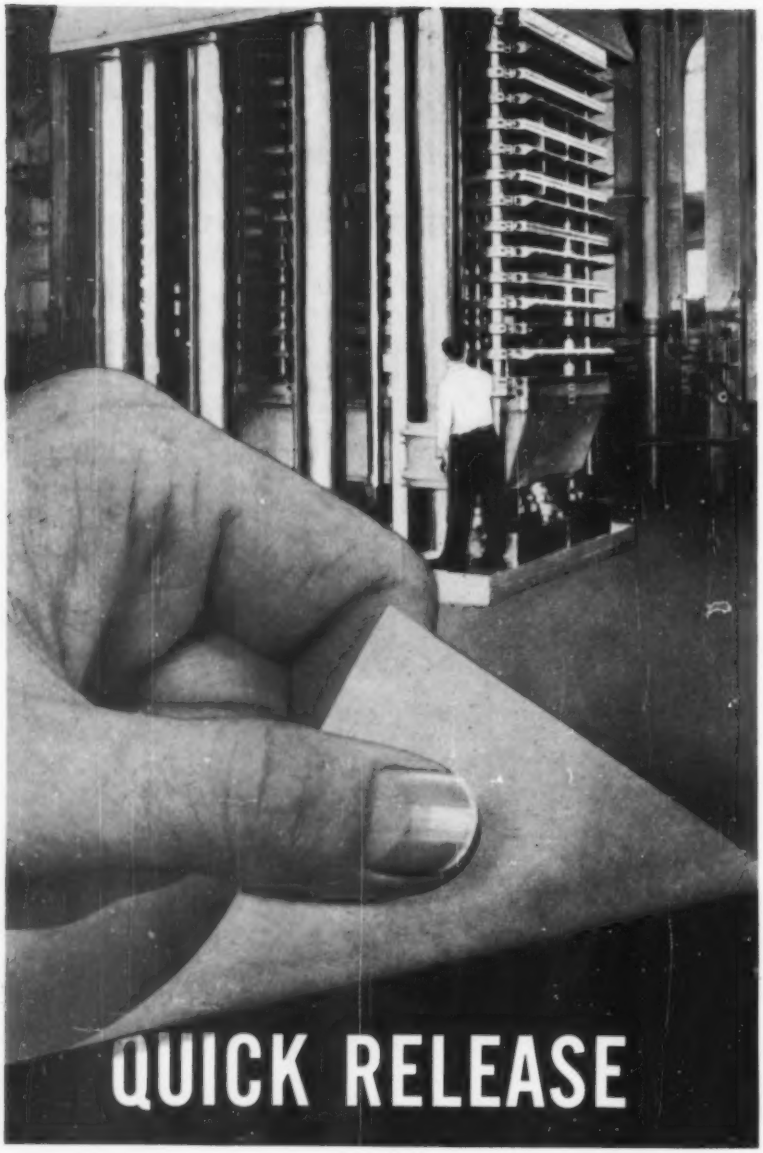
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resins are now in several forms, viz: coated sand, pulverized, water borne, and alcohol borne. Several large foundries have now adopted them, and Ford and General Motors have put them in production lines. But they have by no means completely displaced other types of foundry casting or molding. There is still a lot of room to grow, although about 20 million lb. of resin are estimated to have been used for this purpose in 1959 and a 50-million-lb. figure is generally expected to be reached in the late 1960's.

A growing use of phenolic resin to bond wood waste is showing up each year—it is now challenging urea for a larger portion of the particle board market, and this product is growing into a vast volume. The resin amounts to only from 6 to 12% of the finished product and therefore isn't mountainous in volume—perhaps 6 or 7 million lb. in 1959 with a possibility of doubling that amount in the next 10 years or less as particle board becomes more commonplace. Such applications as toilet seats, hamper tops, laminate cores, public seating, and similar products are in this category.

The adhesive use of phenolic as distinguished from bonding is not in very large volume compared to many other phenolic uses but it's mighty powerful glue and is gradually working its way into more and more markets.

Other uses in the miscellaneous category are for rubber reinforcement in shoe heels, Microballoons used in the petroleum industry tanks to prevent evaporation, foam, and innumerable items that defy definition.

There is considerable feeling that the ratio of growth in these industrial or liquid phenolics may be much greater than the growth of phenolic molding materials, but the pattern of potential growth is hazy and difficult to define. Perhaps it is just a hunch, but the producers seem confident even though they are not pointing out specific large-volume potentials. It is one of those industries in which a newcomer might risk his shirt, but for most of those who are already there it holds promise of modest but not sensational growth.—**End**

Urea and melamine

(From pp. 111-112)

possibility that an avalanche of low-cost thermoplastic tableware may flood the market and that its performance would reflect on all plastics tableware. Melamine dinnerware producers are campaigning to convince customers of the great difference in properties between melamine and thermoplastic dishes. The thermoplastics people are after a lower-cost market and make no claims of equalling melamine; but, just the same, their product is sold as plastic tableware.

The year was marked by a number of changes in the dinnerware industry background that started a year earlier. There were a few drop-outs, but new molders came in. There were consolidations among those already in the business. Most of the important chinaware people have now moved into the melamine business and either mold their own or have inter-company relations with a molder. And from a marketing point of view, the supermarkets jumped to the front as a retail outlet.

The usual design improvement was quite noticeable in 1959, but the changes were not so radical as in previous years. Most molders now use foil overlays to obtain color effect and one or two have adopted a color decorative system. The tableware now looks more like china with a translucent appearance and high style lines that compare with the finest china. The approach to thin edges that look thin but really are not gives a quality appearance.

But the word "thin" is not a happy one to resin producers. There is always the danger that some molders will attempt to lower standards and reduce the thickness of the walls, thus producing an inferior product that will create customer complaints and suspicion of quality dinnerware. The minimum thickness for cups is 0.090 in. and goes up from that to 0.100 in. for 9¾ in. diameter plates. Anything below that cannot carry the trademark of the resin producers.

Improvements in resin and molding technique have been a great aid to quality and manufacturing processes in the last few years. Speed of operation has increased as much as 50% in some plants. Any molder who hasn't installed better pumps to increase ram speed and altered his equipment to keep up with competition is in trouble.

Other melamine applications have not changed much from previous years and account for less than 10% of the total resin production. Bowls, now made mostly by tableware molders, are seen everywhere in the market place. An interesting increase has been in ash trays—the industry is now using as much resin for them in a month as it once did in a whole year.

Other applications are electric shaver housings, housings for appliances, soda fountain sirup jars, a few telephone sets, wiring fixtures, closures—where urea isn't feasible—cutlery and paint brush handles, and warming dishes.

Melamine molding material in industrial applications is not big volume, but is useful where cheaper materials are unsatisfactory. One problem is to find the markets—the user generally has to discover by himself that melamine fits his need. Glass-filled melamine, for example, used in connector plugs and other electricals, has outstanding electrical properties, dimensional stability, impact strength, heat resistance, and better arc resistance than most other material. But it sells for from 85¢ to $1.05/lb. An-as-bestos filled melamine sells for 65¢, and rag for 51¢, in contrast to cellulose-filled melamine at from 42¢ to 50¢ a pound.

Changes in the marketing aspects of urea molding powder have been conspicuous in the last few years. Buttons, wiring devices, and closures were the three leaders ever since World War II, with the respective poundage volume fluctuating from year to year. But there has been a change in the last three or four years.

Closures now take about half the urea molding powder. If it were not for competition from thermoplastics the volume would be considerably more. Urea and phenolic are still claimed to be the best of materials for closures

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because of their strength and chemical resistance, but the customer is being wooed away by lower-cost thermoplastics.

Wiring devices use up from 20 to 25% of the urea output. The color consciousness of housewives has helped this market show a small increase.

Buttons and custom molding take the rest of the urea available. Urea buttons have been declining for a couple of years largely due to the advent of polyester buttons. The latter are asserted to be no improvement in price or properties but they have a pearlescent effect or appearance that pleases the customer. So far there has been no luck in trying to capture this same effect in urea.

Other molded items in urea are about the same as always; stove hardware, poker chips, a few radio cabinets in a market that was once tremendous, scale housings, cutlery boxes, etc. Urea telephones and toilet seats are in wide use in England, but have never made much dent in the market in the United States.

Two developments during the year attracted considerable attention. The Plastics Division of Allied Chemical brought out a new fire-resistant urea resin, which has met Underwriters' Laboratories requirements, and which represents a reported 10-fold improvement over standard urea. It reportedly will not crack, drip, sag, or readily contribute to flame spread and minimizes the possibility of "hot spots" arising from overload or long use. It has good electricals, minimum of dust attraction, resistance to detergents, and is easy to clean. It is expected to be in demand particularly for lighting fixtures.

The same company also came into production with a wood-filled 17½¢ black and brown urea that is suggested for wiring devices and closures. A similar material was brought on the market several years ago and practically abandoned. This same type material, however, is said to be widely used in Europe.

The future for urea molding material in this country seems to demand the introduction of new markets. Time after time a new use has looked promising and then succumbs to other materials. An example was the large colored urea television cabinet of a few years ago. It was just developed and then, zing!—it was lost to a low cost metal cabinet. A lower cost than the current 34¢ price might help, but producers claim not enough to broaden the market appreciably. There is still lots of research going on by ammonia companies who are probing the possibilities of producing a lower cost urea molding material.

However, the companies now in the business have certainly provided vast improvement in the resins available—they are so far ahead of the older varieties that comparsion is almost ridiculous. They have much better control of their production processes, have minimized contamination and are producing much larger batch sizes on an assembly line set-up. They have reached the point where urea production is a science rather than an art.—**End**

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(*From pp. 170-172*)

of polyethylene," by I. L. Hopkins and O. W. Baker, United States.

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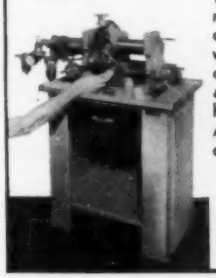
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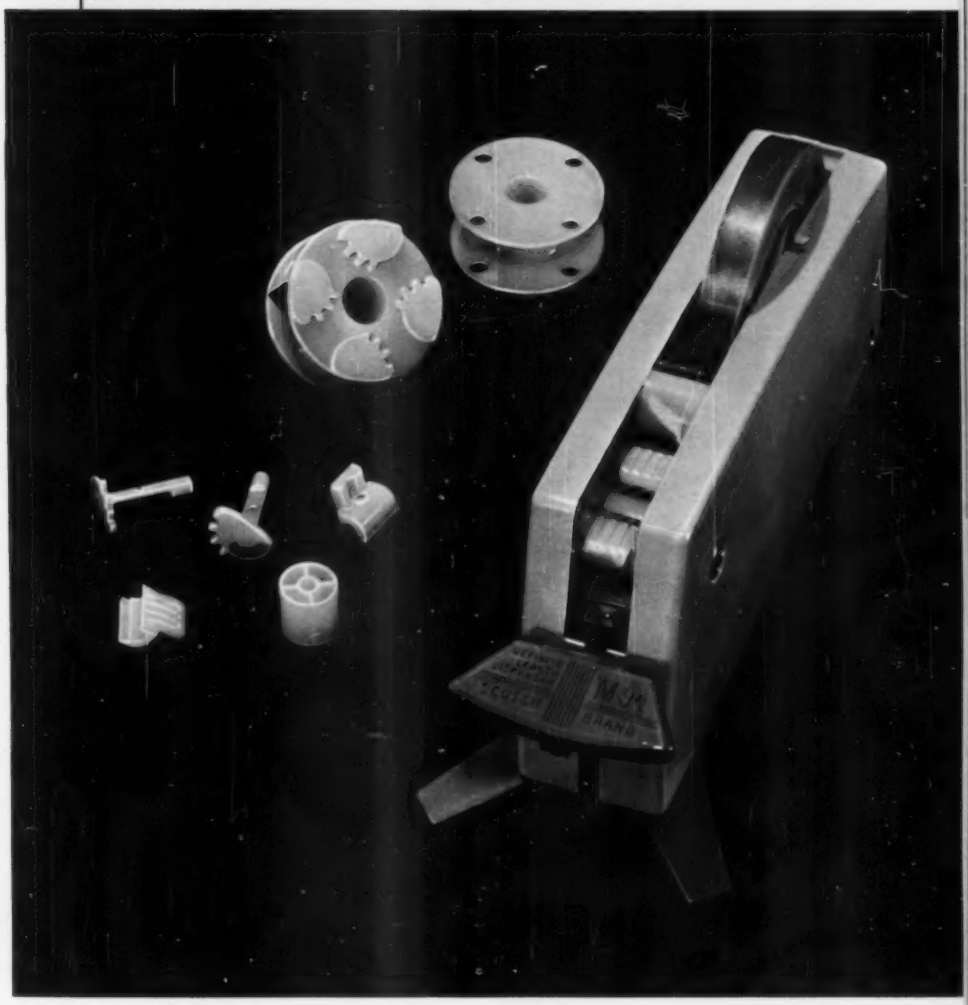
the two variables is the same for degradation by photolysis and by heat. Under the influence of catalysts, aging, i.e., degradation rates, may increase without actual change of the constants of the equation that describes the relationship between the changes of mechanical strength and degree of polymerization. One of the constants of the equation is a sort of material constant and is related simultaneously to light stability and electrostatic behavior of the pure material. It is shown that the more light resistant a synthetic fiber is, the smaller is the tendency towards positive charging. The clear picture obtained from the aging behavior of filaments will be of considerable help to unravel the complicated processes that take place in solid plastic bodies.

"Research problems and results concerning the behavior of plastics materials exposed to aging," by P. Dubois, France. The usefulness of forecasting aging of materials has led to accelerated tests, particularly in the application of radiation from various sources. It must, however, be stated that correlation between the results of natural and artificial aging is extremely doubtful, if it exists at all, in perhaps two-thirds of all cases. The problem of establishing this correlation and methods of evaluating it have been examined in this paper in the hope of improving such forecasts. It would seem proper to hope that this correlation might be obtained, in the case of various climatic types, as follows: a) By forecasting typical aging for each type of climate, and in particular aging brought about by radiation: carbon arc spectrum for climates rich in ultra-violet light; Xenon lamp spectrum for all other cases; and it may even be that the Xenon lamp would be best for all kinds of climates. b) By studying the changes in the hydrothermal sensitivity of two categories of carefully chosen characteristics after a repeated hydrothermal cycle corresponding to the climate under consideration. This cycle should include both maximum and minimum temperatures, and degrees of humidity of the climate, and should be comprised of both slow periods of change and quick periods of change. c) By exploiting, and adding to, known facts concerning different climates from the point of view of temperature and humidity, and their annual distribution. Also the annual radiation received in various bands of the spectrum should be studied and the most suitable lamps for each climate should then be chosen.—**End**

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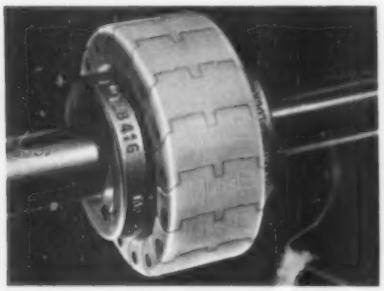
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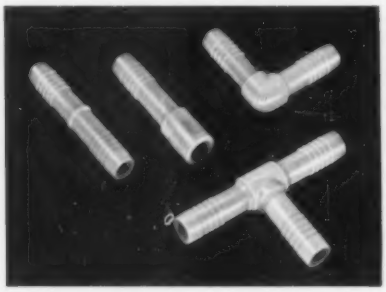
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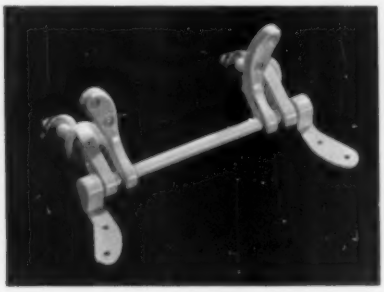
Complex moldings of ZYTEL® resist wear... corrosion... low temperatures



FLEXIBLE COUPLING made of links of ZYTEL outlasts metal chain coupling up to 6 to 1 and costs 20% less to buy and maintain. Coupling is clean, quiet, corrosive-free. (By Berea Plastics Co., Berea, O., for Morse Chain Co., Ithaca, New York.)



PIPE FITTINGS molded of ZYTEL are used to connect plastic pipe with plastic or metal pipe. Pressure grooving and threads are molded into the complex hollow shapes. The parts have high strength and chemical resistance. (By Yardley Plastics Co., Columbus, O.)



TOILET-SEAT HINGE made of ZYTEL is virtually indestructible . . . noncorrosive, rustproof . . . highly resistant to stain or discoloration. Easy-to-clean hinge never peels, cracks or chips. (By Bemis Manufacturing Corp., Sheboygan Falls, Wisconsin.)

When parts of any kind are subjected to rugged treatment, moldings of ZYTEL nylon resins usually give longer wear at lower cost. Because of an unusual combination of properties, parts of ZYTEL are equipped to withstand conditions that would reduce the life of ordinary materials. ZYTEL is easily molded into complex shapes and has exceptionally high strength in thin sections. Its resistance to temperature extremes allows reliable use under such conditions. Resisting corrosion, ZYTEL is ideal for use requiring exposure to the elements or to chemicals. Light in weight, it resists abrasion and impact. Du Pont ZYTEL may help you save money by reducing production costs and giving improved performance under adverse conditions. Find out how by filling out and sending in the coupon below.

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ZYTEL® *nylon resins*

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Alathon® · Delrin® · Lucite®

Engineering highlights

(*From pp. 134-149*)

a small amount of blowing agent in a vinyl compound a high density cellular vinyl product can be made by direct extrusion. During extrusion the decomposition of the blowing agent generates gas in the barrel of the extruder. As the plastic mass emerges from the die, it expands to a cellular structure. This method can be used to produce foams with densities of 40 to 75 lb./cu. ft. Formulation, processing techniques, and foam properties are discussed.

"Coloring wire jackets," by ***S. Vicino Jr.,*** *Rubber Age 84,* 795 (Feb. 1959).

Article describes equipment used for painting extruded PE, PVC, and Neoprene coated electrical wire as it is extrusion coated on the line. Painting makes changes of color easy and reduces the number of colors a wire coater needs to carry in inventory as well as allowing the use of natural colored materials with better electrical properties.

"What a plastics engineer should look for when planning to buy auxiliary equipment for extrusion," by ***R. E. Monica,*** *Plastics Tech.* **5, 67 (Sept. 1959).**

A summary discussion of hopper loaders, hoppers, ovens, controls, scrap guiders, take-away equipment, blow molding equipment, and how this equipment can be used to make sheet, film wire, profiles, etc. As an appendix, data on extrusion and blow molding machines, as well as a directory of auxiliary equipment suppliers are included.

"Basic laws for plastics screw extruders—Parts I, II, III," by ***G. Schenkel, Kunststoffe 49,*** **1, 2, 3 (Jan., Feb., March 1959).** In German.

Parts I and II analyze the basic factors in single-screw extrusion and offer suggestions on the solution of problems arising in various zones of the screw. In the third part of the series theoretical relationships are presented which describe a complete solution to the action of the screw.—**End**



NEW STOKES 72" VACUUM COATER

Shortens cycles, speeds production and provides more flexible operation

A highly versatile pumping system is the chief reason behind the increased efficiency and flexibility of Stokes new 72" Vacuum Coater. Employing a new "modular" approach to vacuum system design, the new arrangement provides greater pumping capacity and operating versatility . . . at no increase in cost. Pumping down the clean dry chamber can now be accomplished in 4½ minutes or less.

Here's how the modular system works: two separate but identical "teams" of pumps are connected independently to the vacuum chamber. In normal operation both "teams" are used. However, either team may be cut out for periodic maintenance or isolation without shutting down the entire metallizer. It's a real time and cost saver. And to make the equipment even more versatile, a third pump can be easily added.

The new "modular" approach is one more example of progress in vacuum technology at Stokes. Whether it's vacuum metallizing of decorative parts or high-precision components, Stokes experience helps lead the way to greater operating efficiencies. Why not find out how Stokes will help plan your metallizing facilities . . . select the proper equipment . . . train operators. Your nearby Stokes field engineer will be glad to discuss your particular requirements . . . and to make available the facilities of Stokes Laboratory and Advisory Services.

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POLY-KLEEN: A liquid cleaner for removing lacquer over-spray, grease, adhesives, etc. from polystyrene. Will not craze or mar even the thinnest sheet.

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MANUFACTURERS OF DYES—LACQUERS—CLEANERS—ADHESIVES— FOR PLASTICS

1959 in review

(From pp. 151-168)

differential thermal analysis (495), and electron microscopy (496) studies of the chemical and physical structures. Analytical methods were developed for the determination of hydroxyl (497), bound styrene (498, 499), acrylonitrile (500-502), carbon black dispersion (135), aluminum and titanium in PE (134), epoxy groups (503), methylphenyl ratio in silicones (504), dialkyltin compounds in PVC (505), and cellulosic compounds (406-508).

Standards

A.S.T.M. Committee D-20 on Plastics (509) made notable progress during the year on the development of new test methods and specifications, particularly for cellular materials and nuclear radiation exposures. Standards approved included eight new methods of test, three new specifications, and two new recommended practices, as well as revisions of eight test methods, three specifications, and definitions of terms relating to plastics. The new specifications were for extruded acrylic plastic sheet (D 1547-59T), allyl molding compounds (D 1636-59T), and thermosetting reinforced plastic pipe thread system (D 1694-59T). The new test methods covered compressive strength (D 1621-59T), apparent density (D 1622-59T), and tensile properties (D 1623-59T) of rigid cellular materials, chemical analysis of urethane foam raw materials (D 1638-59T), flammability of plastic foams and sheeting (D 1692-59T), tensile heat distortion temperature of plastic sheeting (D 1637-59T), environmental stress cracking of Type I ethylene plastics (D 1693-59T), and gamma radiation by chemical dosimetry (D 1671-59T). The new recommended practices pertained to exposure of polymeric materials to high energy radiation (D 1672-59T) and operating light- and water-exposure apparatus of the carbon-type for exposure of plastics (D 1499-59T). Also noteworthy are the specification and methods of test for closed cell sponge made of polyvinyl chloride or copolymer thereof (D 1667-59) adopted by A.S.T.M. Committee D-11 on Rubber and Rubber-like Materials (510) and the following four new methods of test adopted by A.S.T.M. Committee D-9 on Electrical Insulating Materials (511): dielectric constant and dissipation factor of expanded cellular plastics used for electrical insulation (D 1673-59T); testing electrical grade polytetrafluoroethylene tubing (D 1675-59T); testing polymerizable embedding compounds used for electrical insulation (D 1674-59T); and testing flexible vinyl plastic coated sleeving used for electrical insulation (D 1678-59T).

Seven Commercial Standards for plastic products were published during 1959. The new standards covered flexible polyethylene plastic pipe (CS197-59), rigid ABS plastic pipe (CS218-59), dimensions and tolerances for

493. "Fractionation of polymers by precipitation chromatography," by S. R. Caplan, J. Poly. Sci. *35*, 409 (Mar. 1959).
494. "Tracer technique in polymer chemistry," by J. C. Bevington, J. Sci. Ind. Res. *17A*, 106 (1958).
495. "Thermistorized apparatus for differential thermal analysis," by J. M. Pakulak, Jr., and G. W. Leonard, Anal. Chem. *31*, 1037 (June 1959).
496. "Electron microscopy of high polymers," by N. H. Langton and M. Stephens, Plastics *23*, 422 (Nov. 1958).
497. "Determination of hydroxyl concentration in polypropylene glycols by infra-red spectroscopy," by E. A. Burns and R. F. Muraca, Anal. Chem. *31*, 397 (Mar. 1959).
498. "Determination of bound styrene in raw and cured polymers by nitration," by C. L. Hilton, J. E. Newell, and J. Tolsma, Anal. Chem. *31*, 915 (May 1959).
499. "Spectrophotometric determination of styrene in a styrene-methyl methacrylate copolymer," by A. V. Tobolsky, A. Eisenberg, and K. F. O'Driscoll, Anal. Chem. *31*, 203 (Feb. 1959).
500. "Polarographic determination of residual acrylonitrile in polymeric systems," by G. C. Claver and M. E. Murphy, Anal. Chem. *31*, 1682 (Oct. 1959).
501. "Determination of vinylpyridine, acrylonitrile, and acrylic acid units in elastomeric polymers," by J. E. Burleigh, O. F. McKinney, and M. G. Barker, Anal. Chem. *31*, 1684 (Oct. 1959).
502. "Analysis of acrylonitrile-methylvinylpyridine copolymers," by Stafford, Jr., and Toren, Anal. Chem. *31*, 1687 (June, 1959).
503. "Determining epoxy contents of cured and uncured resins," by H. C. Anderson, Plastics Tech. *5*, 40 (July 1959).
504. "Determination of the ratio of methyl to phenyl groups in silicone polymers," by Lady, Bower, Adams and Byrne, Anal. Chem. *31*, 1100 (June 1959).
505. "Determination of dialkyltin compounds in polyvinyl chloride," by A. H. Chapman, M. W. Duckworth, and J. W. Price, Brit. Plastics *32*, 78 (Feb. 1959).
506. "Titrimetric determination of nitrogen in nitrocellulose and of nitrocellulose in double-base propellants," by R. H. Pierson and E. C. Julian, Anal. Chem. *31*, 589 (Apr. 1959).
507. "Gravimetric determination of cellulose acetate in double-base propellants," by A. N. Fletcher, R. H. Pierson, and E. S. Gantz, Anal. Chem. *31*, 1224 (July 1959).
508. "Colorimetric determination of methylcellulose with diphenylamine," by Kanzaki and Berger, Anal. Chem. *31*, 1383 (Aug. '59).
509. "Report of A.S.T.M. Committee D-20 on Plastics," Proc. A.S.T.M. *59*, preprint (1959).
510. "Report of A.S.T.M. Committee D-11 on Rubber and Rubber-like Materials," Proc. A.S.T.M. *59*, preprint (1959).
511. "Report of A.S.T.M. Committee D-9 on Electrical Insulating Materials," Proc. A.S.T.M. *59*, preprint (1959).

solvent-welded rigid ABS plastic pipe (CS219-59) and lightweight rigid ABS plastic pipe (CS220-59), gelcoated glass-fiber-reinforced polyester resin bathtubs (CS221-59) and shower receptors (CS222-59), and polyethylene film (CS227-59). Three proposed Commercial Standards have been circulated to industry for approval, as follows: plastic drain and sewer pipe and fittings, styrene-rubber type (to be issued in January 1960 as CS228-60); rigid polyvinyl chloride pipe (TS-5454); and vinyl plastic weatherstrip. SPI Committees have work nearing completion on proposed standards for vinyl-metal laminates, polytetrafluoroethylene sheet, and flexible reinforced fluorocarbon tubing, and revisions of Commercial Standards for polystyrene wall tile adhesive, vinyl film, rigid polyethylene pipe, Type II solvent-welded acrylonitrile - butadiene - styrene pipe, PE film, and corrugated plastic structural panels.

Technical Committee 61 on Plastics of the International Standardization Organization (512) completed action on 14 Draft ISO Recommendations at its 1959 meeting in Munich and approved four new Draft ISO Recommendations and six Draft Proposals. The new recommendations pertain to methods for softening point of thermosetting materials, acetone-soluble matter of phenolic resins, viscosity number of polyamides, and thermal stability of vinyl chloride polymers. The draft proposals concern methods for tensile properties, stiffness, resistance of plastics to natural and artificial light, setting time and temperature of polyesters, and change in mechanical properties of plastics in contact with chemicals. Another ISO document of interest to the plastics industry is Draft ISO Recommendation No. 282, Pipes of Plastic Material for the Transport of Fluids, prepared by Subcommitte 6 of ISO/TC 5 on Pipes and Fittings. This document provides for standard external diameters in millimeters and standard nominal pressures (working pressures at 20° C.) in kgf./cm.^{2} It is intended to serve as a guide to manufacturers and users, and as a basis for specific standards for a given material or a definite field of application.

The American Society of Mechanical Engineers published Section 11 on Plastics of the American Drafting Standards Manual, ASA Y14.11-1958, which contains design information on wall and section thicknesses, ribs, bosses, draft, taper, fillets, radii, flash lines gates, holes, undercuts, inserts, threads, surface quality, warpage, tolerances, assembly methods, and lettering, as well as embossing (513).

A standard covering property requirements and test methods for polystyrene to be used in lighting luminaires was approved and issued by the Illuminating Engineering Society (514).—**End**

512. "Report on International Meetings," Modern Plastics *37*, 170 (Jan. 1960).

513. "Drafting standard on plastics aids designers," by H. E. Minneman, Magazine of Standards *29*, 362 (Dec. 1958).

514. "Recommended light characteristics of polystyrene used in illumination. Standard prepared by I.E.S.-S.P.I.-N.E.M.A.," Modern Plastics *37*, 142 (Sept. 1959).

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THE PLASTISCOPE*

News and interpretations of the news

By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 41)*

January 1960

Plastics in refrigeration

A symposium on plastics in domestic refrigeration will be presented on February 1, 1960, in Dallas, Texas, before The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) at its annual National Conference, by The Society of the Plastics Industry, Inc.

The keynote talk, "Should plastics be used in refrigerators?" will be given by Wayne L. Farley, Vice Pres., White Stores, Inc., Wichita Falls, Texas, representing ASHRAE viewpoints. Other papers include "Realistic properties of plastics materials applied to the requirements of the refrigeration industry," by William E. Brown, The Dow Chemical Co., Midland, Mich., representing SPI; and "Assurance of satisfactory performance of plastics parts in refrigeration," by Dale Amos, Amos Molded Plastics Div., Edinburg, Ind. Panel personnel include: R. B. Akin, Du Pont; R. W. Barber, Panelyte Div., St. Regis Paper Co.; R. H. Carey, Union Carbide Plastics Co.; L. H. Gustafson, Pro-Phy-Lac-Tic Brush Co.; C. K. Henry, Celanese Plastics Corp.; B. M. Nathanson, Monsanto Chemical Co.; D. P. Shedd, Mobay Chemical Co.; and G. B. Thayer (moderator), The Dow Chemical Company.

For one-shot urethane foams

Two organotins and two inorganic tin compounds have been added to the range of catalysts manufactured by Metal & Thermit Corp., Rahway, N. J., for the production of urethane foams. The organotins are dibutyltin di-2-ethylhexoate; and dibutyltin dilaurate; and the inorganic compounds are stannous octoate and stannous oleate. These catalysts are especially suitable for the one-shot method of producing polyether urethane foams, because they are said to balance the basic chemical reactions that take place during the actual foaming process.

The Silicones Div. of Union Carbide Corp. has reduced the price of L-520 and XL-521 organosilicone copolymers from $2.90 to $2.65/lb. in 5-gal. drums, and from $2.80 to $2.56/lb. in 55-gal. drums. These fluids are widely used as surfactants in the manufacture of one-shot urethane foams.

Butyrate skin packages

Vacuum-formed skin packages made from transparent butyrate film do double duty by protecting molded butyrate fish lures from dust and soil and preparing them for rack merchandising.

The lures, molded of Eastman Chemical Co.'s material by Les Davis Fishing Tackle Co., Tacoma, Wash., give fast, live action and have high impact resistance.

The film is extruded by Transparent Products Corp., San Francisco, Calif.

Plastisol for air-dry coatings

Developed by Sel-Rex Corp., Nutley, N. J., Armor plastisol can be sprayed, painted, or dipped in thicknesses of 40 mils or more, for plating rack development, patching, or general protective maintenance, the company states.

The material is said to adhere to any metal or other coatings regardless of how applied, producing a tough, non-contaminating insulator-surface. Requiring no ovens, special skill, or facilities to apply, coatings air-dry for use in approximately 30 minutes.

Castor oil foam

Urethane resin systems based on especially modified castor oil derivatives are said to provide a more economical method for foaming-in-place applications than is available with conventional urethane systems. Developed by Baker Castor Oil Co., Bayonne, N. J., the system bypasses the manufacture of a prepolymer. Instead, it substitutes components of almost equally low viscosity that can be easily foamed from a newly available light-weight, compact, dual-headed spray gun employing air pressure. This new equipment is said to eliminate the need for proportioning pumps, thus reducing equipment cost to 20% of previous methods, the company claims. Urethane foam preparations are often based on combining a very viscous prepolymer with a low viscosity catalyst.

The main markets for the castor oil foams are thought to be in the thermal and acoustical insulation fields; in packaging; core construction; and similar applications. According to Baker, low density foams ranging from 1.5 to 2 lb./cu. ft. exhibiting no after-shrinkage can be sprayed without sagging on vertical surfaces in any thickness desired. Decorative effects similar to stucco can also be achieved.

Castor oil urethane foams—which, like other urethane foams, use tolylene diisocyanate as a major chemical ingredient—have very good self-bonding properties, and greater fire resistance than most other types of urethane.

RP fencing

The first large-scale industrial use of glass-reinforced plastic panels made with acrylic sirup has been completed at Du Pont's Chambers Works, Deepwater, N. J. Alternate panels of yellow, green, and orange were selected to give a color accent to a visitor's parking lot and screen out the view of a disposal and storage area nearby. Sunlight passing through the translucent sections adds brilliance to the color effect.

Long experience with other outdoor applications indicates that the fencing **(To page 236)**

* Reg. U. S. Pat. Off.

News about R&A SINCE 1913 **Adhesives**

FOR ALL METALS AND ALL PLASTICS

New "room temp" curing epoxy adhesive spreads like cold cream

TECHNICAL DATA ON

Bond*master*® M688

A thixotropic, room temperature curing, 100% reactive, two-component, solvent-free modified epoxy adhesive designed for bonding metals and rigid plastics as well as other rigid materials to themselves and to each other.

APPLICATION

Mixed BONDMASTER M688 is soft and buttery, making it extremely easy to spread smoothly and evenly. Once applied, it maintains its form and DOES NOT FLOW during the curing cycle. Excellent for "poor fit" and similar void-filling applications as well as where dripping or running of adhesive cannot be tolerated.

CURE

Bonded assemblies which have been cured at room temperature can be handled in 4 to 6 hours and develop 85% of their maximum strength in 14 to 24 hours. Alternately, where practical, any of the following heat-cure cycles may be used to achieve full strength more rapidly: 100°F for 2 hours; or 150°F for 30 minutes; or 200°F for 15 minutes; or 250°F for 10 minutes. See Technical Data Sheet for alternate hardeners, pot life, cure cycles, etc.

BOND CHARACTERISTICS

Fully cured bonds exhibit minimal shrinkage, are electrical insulators, and provide excellent resistance to weather, galvanic action, and most chemicals, acids, and alkalies.

R&A SINCE 1913

RUBBER & ASBESTOS CORPORATION

243 BELLEVILLE AVENUE
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Here is why you can save valuable application time as well as material costs with this 100%-reactive, solvent-free epoxy adhesive, BONDMASTER M688:

- Smoothly, easily spreadable with trowel, spatula, knife edge, etc.
- Non-sag (thixotropic) in any position . . . even while curing. Eliminates costly cleanup.
- Cures at room temperature in about 24 hours . . . or in as little as 10 minutes if you can heat to 250°F.
- 100%-reactive . . . no waiting for solvent evaporation . . . mere contact pressure is sufficient.
- Solvent-free . . . no danger of attack on soluble thermoplastics (cells of foamed polystyrene, for example).

ALL METALS—ALMOST ALL PLASTICS

You'll get strong (in excess of 2,000 psi tensile shear on aluminum-to-aluminum, for example) bonds with cast iron, steel, stainless, magnesium, aluminum, copper, brass, bronze . . . *any* metal . . . to themselves or to just about *any* plastic—rigid, foamed, or flexible.

And, of course, to glass, ceramics, wood, and structural laminates based on reinforced melamine, polyester, phenolic, epoxy, etc., resins.

WRITE FOR FURTHER DATA

Write for detailed Technical Data Sheet today. We'll be glad to send a free sample as well if you will describe your bonding problem in detail.

THE PLASTISCOPE

(*From page 234*)

should retain its color and high gloss without painting or other maintenance costs inherent in conventional materials.

The fence was made by Russell Reinforced Plastics Corp., Lindenhurst, N. Y. Cost of materials, including redwood and 3000 sq. ft. of panels of Lucite, was $2800.

Foster Grant earnings

In the first annual report since selling stock to the public, Foster Grant Co. Inc., Leominster, Mass., reported net earnings of $1,744,191 or $1.51 per common share for the fiscal year ended September 27, 1959, an increase of 71% over net earnings of $1,017,180, or 88¢ per share for the like period for 1958.

Joseph C. Foster, president of the chemical and plastics company, reported sales of $29,340,189 for 1959, compared to $22,946,719 for the 1958 fiscal year, an increase of 28 percent.

Prepreg committee

The Reinforced Plastics Div. of The Society of the Plastics Industry Inc. has formed a Prepreg Committee made up of representatives of companies in this segment of the industry. The committee is directing its initial efforts to consideration of the standardization of test methods and nomenclature. As part of the program, a tack meter, developed by the committee chairman, Grant Brown, Cordo Chemical Co., Mobile Plastics Div., Mobile, Ala., is being evaluated by members as part of a round-robin test.

For laminating film

Vinyl-acrylic copolymer solution, said to have exceptional utility for laminating or formulation of pressure-sensitive adhesives, is now being offered by the Resin Div. of National Starch & Chemical Corporation.

Designated Resyn 26-2404, the new material is tacky and shows specific adhesion to cellulose acetate, Mylar, vinyl, nylon, PE, saran, paper, and foil. In addition, it can be used as a printing ink vehicle. The new resin can be thinned with inexpensive solvents and is said to be compatible with a variety of modifying resins.

Plastics for scale models

A wide variety of plastics structural shapes for industrial modelbuilders have been added to the line of piping and pipe fittings supplied by Industrial Models Inc., Wilmington, Del.

The structural shapes are made of steel gray impact polystyrene and are available in I's, H's, angles, channels and T's, in sizes ranging from ⅛ to 1¼ inches.

PE milk cases cost less

Six months after the introduction of a milk case made of Phillips Chemical Co.'s Marlex polyethylene, Baker Box Co., Worcester, Mass., has reduced the price of these containers by 30%—from $4.50 to $3.25—for volume purchasers. The same unit was competitive at the old price with all types of boxes which were previously used.

Baker expects to sell 6 or 7 million of its standard 16-qt. carrying units in the next 12 months. This is said to represent 20% of the total market.

Dextran formals

Use of formaldehyde in the production of plastics, water emulsion, and other materials has been extended by The Commonwealth Engineering Co. of Ohio, Dayton, Ohio, through the development of a new family of dextran formals. These are reactive products that form building blocks for additional synthesis.

These new formals are said to be so simple to produce and require such inexpensive processing equipment that they are economically attractive for a wide range of applications.

For better PVC stability

Claimed to have twice the heat resistance of similar products on the market, Advastab T-360, a crystalline organotin, has been introduced by Advance Solvents & Chemical, New Brunswick, N. J. The new stabilizer is said to increase the heat distortion temperatures of rigid vinyls by 8 to 12 degrees and to give unexcelled heat and light stability in one package, according to the company.

With this new stabilizer, the finished product is said to be stabilizer odor-free; retain original resin heat distortion; have uncompromised formulation for optical clarity, proper lubrication control, atmospheric staining control, and plate-out processing.

Withstands high temperatures

A molding material compounded of fibrous potassium titanate and a new high temperature phenolic resin has been developed by Resisto Chemical Inc., Wilmington, Del. Parts made of the new material, called Resistotemp, are said to withstand temperatures to 6000° F. for limited periods and sustained temperatures to 1000° F. The moldings are also said to offer high sound absorption and a high dielectric constant at elevated temperatures. Resistotemp has a density of 1.6.

According to the company, the compound may be molded in conventional matched metal dies, and can be cured in conventional ovens. Adhesive and trowelable materials of similar characteristics are also available.

Styrene for lighting

A medium-high impact polystyrene sheet for indoor display and point-of-purchase applications is now extruded by Cadillac Plastic & Chemical Co.

The new Cadco styrene sheet is formulated to assure light stability and may be used with fluorescent lamps with minimal hazard of yellowing, the company states. It is said to have good light transmission in clear or translucent colors, to be readily formable, and to be lower in cost than any other impact resistant light-transmitting material. It is not recommended for outdoor applications. It is available in flat or in corrugated sheets in either 1-in. or 3-in. corrugations.

Lower price for premix

A price reduction in the Thermaflow line of RP molding compounds and an in- **(To page 238)**

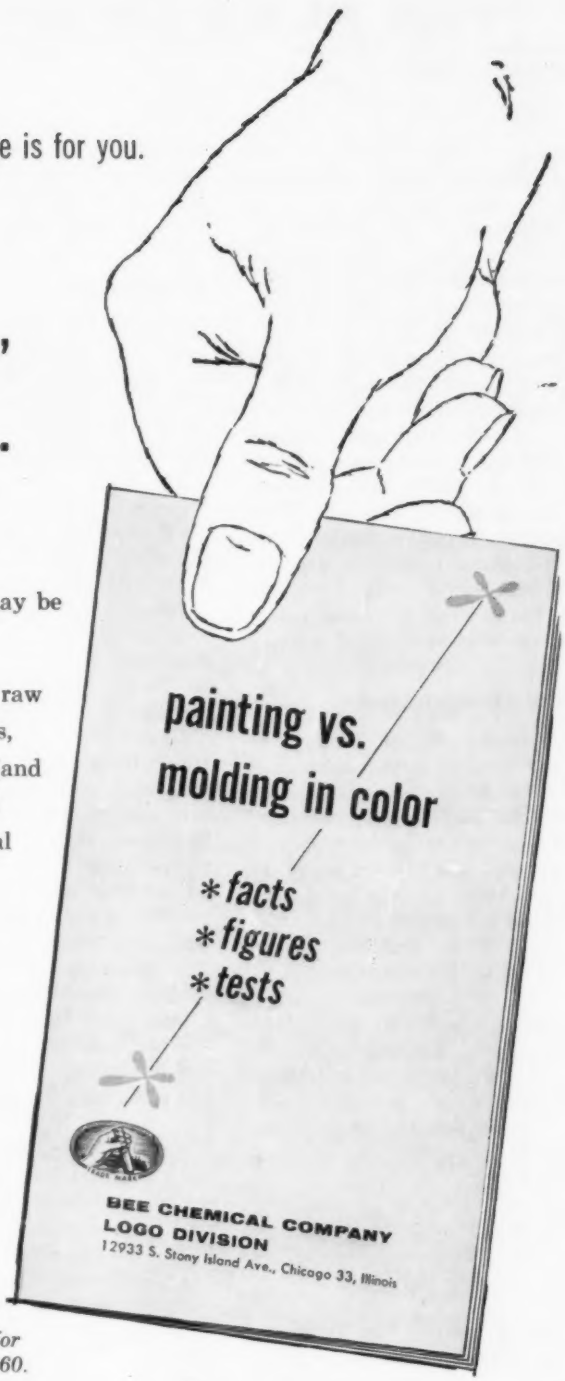
If you buy special-color plastic parts, this message is for you.

This new production "tool" can cut your part costs . . .

If you buy special-color plastic parts, you may be paying more for them than necessary . . .

If your requirements for each special-color raw stock are below maximum-discount quantities, your parts will probably cost less painted (and molded from neutral or reprocessed material) than molded in color. And Bee Coatings equal or better finished part appearance and performance. Color selection—including metallics—is unlimited, offers numerous advantages in addition to low cost.

Painting is a useful production "tool"—not a cure-all. There are cases where painting pays, and others where molding in color is still best. Where pennies count it's wise to figure *every* part both ways—painted *and* molded in color.



Detailed information, including actual costs and other advantages, is yours for the asking. Write now for Bulletin E160.

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This booklet gives you both a summary and complete detailed information about painting on plastics. Actual cost comparisons, plus information about other in-plant savings, make this booklet one you'll want to keep and use . . . and act on.

THE PLASTISCOPE

(*From page 236*)

crease in the number of colors available without additional charge has been announced by Atlas Powder Co., Wilmington, Del. In addition, a new discount schedule has been established for quantities between 9600 and 20,160 pounds.

The largest price cut (9¢/lb.) was made in Thermaflow 800, a glass reinforced compound meeting MIL-M-14E, type MAI-60 specification, which now sells at 60¢/lb. in 20,160 lb. quantities. Thermaflow 105, a high impact general purpose compound, has been reduced 1 to 2¢/lb., depending on quantity, with 40¢/lb. as the lowest price. Two new colors are available at standard price.

New Companies

Commercial Resins Corp., 549 James Ave., St. Paul 2, Minn., has been formed to manufacture polyester and alkyd resins, gel coats, and polyester color pastes in a new plant which is scheduled to go on stream this month.

Philip B. Herman, formerly VP, Mol-Rez Div., American Petrochemical Corp., is president.

Custom Chemicals Co. Inc., Currie Ave., Wallington, N. J., is a new manufacturer of adhesives for laminating; inks for rotogravure and flexographic printing; protective coatings; and pigment dispersions.

Albert J. Capalbo is pres., and **Richard Flicker** is VP. Both officers were formerly with Interchemical Corp.

Vanzo & Rocca, Via Turati 6, Milan, Italy, has been formed to manufacture and sell plastics green houses.

Polymer Dispersions, Inc., Fairport Harbor, Ohio, is a new company which has installed production equipment for polymer color concentrates and dispersions. R & D will be handled at the company's laboratories, but customer service and color matching will be carried out at the Akron laboratories of **Harwick Standard Chemical Co.** Harwick will also handle sales under the Harwick Stan-Tone trade name.

Expansion

Owens-Illinois Glass Co. has increased its production facilities for blow molded high-density polyethylene containers for liquid detergents by adapting an existing plant in N. Kansas City, Mo.

The International Div. of Owens-Illinois will also start production of these containers in Canada and will lease a plant in Toronto, Ontario.

John H. Chapman, previously manager of investment developments for the division, will move to Toronto to become general manager of the plant.

Owens-Illinois acquired **Keystone Brass Works**, Erie, Pa., maker of melamine dinnerware and cast bronze solder fittings. Keystone has two plants, 200 employees, and annual sales of $3 million. The Lake City, Pa., plant, manufacturing melamine dinnerware, has about 100 employees. This operation will be under the **Libbey Glass Div.** of **Owens-Illinois**, and **George B. Skinta**, Owens-Illinois vice president and general manager of Libbey, also heads the melamine operation.

Minnesota Mining & Mfg. Co. will build a $10 million, 14-story administration building at its research center just east of St. Paul, Minn. Site preparation has begun and the building is expected to be completed early in 1962.

Herbert P. Buetow, president, gave the following indication of 3M's size by the time the center is fully developed:

The research and administrative center will expand from today's seven buildings with 560,000 sq. ft. of space to a campus of some 30 buildings with a total area of about 2,200,000 sq. feet.

The number of employees in domestic and Canadian operations will be about 30,000 compared with today's 19,500. Of this number, approximately 10,000 people will work in offices and laboratories on the campus.

Based on projected sales growth and on 3M's determination to continue investing 4 to 4½% of sales for research, it is reasonable to assume that spending for research will about double the 1959 rate of some $17.5 million, according to Mr. Buetow.

Monsanto Chemical Co. will build a multimillion dollar plant in the European Common Market to manufacture its Saflex polyvinyl butyral sheet. The new plant is expected to be in production by late 1960 or early 1961, and the location of the new facility will be announced in the near future.

Saflex polyvinyl butyral is the plastic interlayer used in making laminated glass for automobile and industrial glazing.

Stauffer Chemical Co., New York, N. Y., has acquired **General Foam Products**, Los Angeles, Calif., manufacturer of expanded polystyrene under the brand name of Crest-Foam. The company will be operated as a unit of Stauffer Chemical's Molded Products Div.

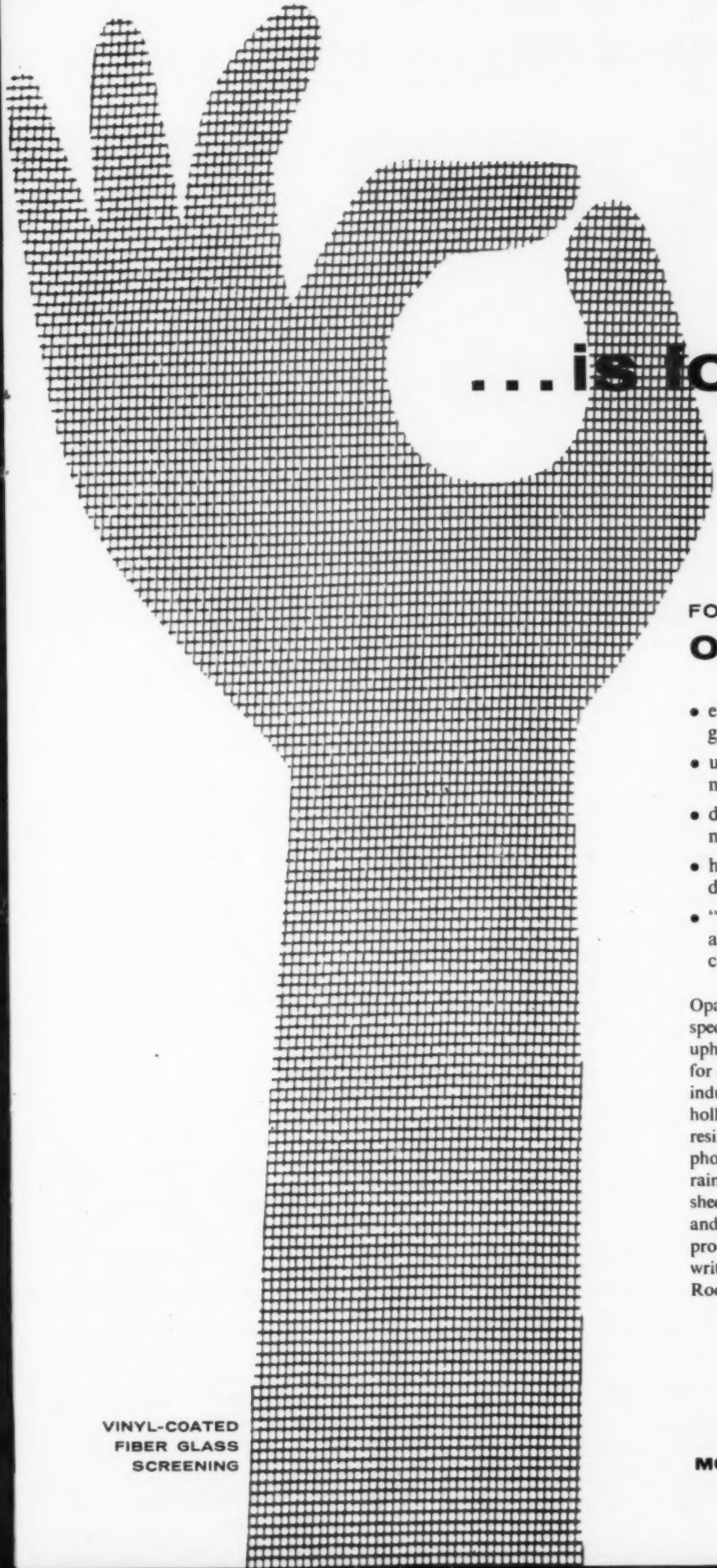
Charles A. Lindsay is president; **John Stauffer**, vice president; and **Frederick N. Cartan** has been appointed manager.

Commercial Plastics & Supply Corp., New York, N. Y., opened its new sales service offices and warehouse at 554 North Ave., N. W., Atlanta, Ga. The new facility will carry the firm's full lines of plastics in sheet, rod, tube, and film forms.

John Gillette has been named general manager in Atlanta.

Textileather Div., The General Tire & Rubber Co., Toledo, Ohio, has started a $65,000 expansion of warehousing facilities. The new warehouse area, which covers 16,000 sq. ft., will increase the finished vinyl fabrics warehousing space at the company's plant by about 50 percent.

Hercules Powder Co. plans a multimillion dollar expansion of its operations at Hercules, Calif., including the construction of new facilities for **(To page 240)**



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THE PLASTISCOPE

(*From page 238*)

methanol, formaldehyde, and urea-formaldehyde concentrates. Construction is expected to be completed by early 1961.

The new facilities will provide for the annual production of 8 million gal. of methanol, 50 million lb. of formaldehyde, and 11,000 tons of urea-formaldehyde compositions. These facilities will be operated by the Explosives Dept. of Hercules.

Glastic Corp., Cleveland, Ohio, manufacturer of fibrous glass reinforced plastics electrical insulation, installed a press for producing 33- by 72-in. laminates. This is the fifth press the company has installed since August 1959. The other four presses are used for premix molding.

The Penn Fibre & Specialty Co. Inc., producers of vulcanized fiber and laminated phenolic sheets, rods, tubes, washers, and fabricated parts, added 2500 sq. ft. to its Philadelphia, Pa., plant.

Perforating Industries Inc., Roselle Park, N. J., is constructing a new 10,600-sq.-ft. plant at 612 Commerce Rd., Linden, N. J. The company will install new and larger machinery for perforating, slitting, and blanking coated fabrics and plastics sheet materials.

Reynolds Chemical Products Co., a division of **Stubnitz-Greene Corp.**, added a 56,000-sq.-ft. wing to the 60,000-sq.-ft. plant at Whitmore Lake, Mich. Reynolds molds urethane foam products and employs about 235 persons.

Plastic Molders Supply Co. has opened a new plant and office at 6200 S. Freeway, Fort Worth, Texas. The new facility will produce and sell a new color gel coat for the reinforced plastics industry, and will also produce color paste dispersions for polyester and epoxy resins.

National Gypsum Co. will build a $400,000 addition to its Town of Tonawanda Research Center, which is expected to lead to the company's entry into the manufacture of new plastics building materials. The 7200-ft. addition will be a pilot plant for the development, testing, and limited manufacture of plastics materials for construction.

Pamarco Inc., Roselle, N. J., has opened a new 20,000-sq.-ft. plant in Batavia, Ill., which will duplicate the N. J. plant's facilities for the production of engraved ink, transfer, and applicator rolls, plate rolls, and base cylinders for the flexographic printing and gravure industries.

Donald W. Donelan, formerly production manager at the Roselle plant, was named general manager of the new facility, and **Ben O. Segermark** will head production.

Finish Engineering Co. has moved from 1115 Cherry St. to a new 26,000-sq.-ft. plant at 921 Greengarden Rd., Erie, Pa., which more than doubles the floor space of the previous building. The company manufactures spray masks, vacuum plating racks and other decorating equipment.

Texas Alkyls Inc. has brought on stream its plant for the commercial production of aluminum trialkyls via the Ziegler process.

Located on the Houston, Texas, Ship Channel, the facility has a rated capacity of about 2 million pounds. The company is owned jointly by **Hercules Powder Co.** and **Stauffer Chemical Co.** The material is a catalyst in PE polymerization.

Rosedale Associated Mfrs. Ltd., London, England, housewares manufacturers, acquired **Kleeware Plastics** from **O. & M. Kleemann Ltd.**, London, England. Kleemann sold the subsidiary in order to concentrate on the company's plastics raw material interests and to withdraw from the plastics consumer goods field. Part of the arrangement provides that the Rosedale group of companies buys substantial quantities of raw materials from the Kleeman group, which also includes **Erinoid Ltd.**, Stroud, England.

Kordite Corp., a subsidiary of **National Distillers & Chemical Corp.**, will construct a new $2 million research and technical service center on a 100-acre site in Macedon, N. Y. The new center will contain facilities for research in plastics and packaging, as well as technical service areas.

Construction will begin early in the spring of 1960, and the two-story, 50,000-sq.-ft. structure is scheduled for full occupancy by January 1961.

Plicoflex Inc. started operations of its new PVC compounding and calendering plant at Houston, Texas. The 40,000-sq.-ft. plant building is currently being used for the production of corrosion-resistant pipeline wrapping tape. Future plans call for the production of a wide variety of plastics goods, ranging from fabrics to rigid board in a wide range of colors and surface finishes.

Mobay Chemical Co. plans to increase its production facilities for tolylene diisocyanate (TDI) to an annual capacity of over 25 million pounds. Work on this third expansion at New Martinsville, W. Va. is scheduled for completion in July, 1960. The company's second expansion, raising its TDI capacity from 12 million to 18 million lb., is now nearing completion.

TDI is one of the principal chemicals used in the manufacture of urethane foams, solid elastomers, and protective coatings.

Ethyl Corp. has increased its commercial capacity for making aluminum alkyls and alkyl aluminum halides with a new plant in Orange, S. C. The plant utilizes a triethyl aluminum process developed by Ethyl. Principal uses for these compounds are in catalysts for the polymerization of olefins, including ethylene and propylene.

Dura-Lee Corp., converter of polyethylene and other packaging materials, has moved into a new 14,000-sq.-ft. plant at 1102 S. Mill St., Kansas City, Kan. The new plant has **(To page 242)**

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THE PLASTISCOPE

(*From page 240*)

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Poly-Cell Plastics Co., Smithtown, N. Y., opened a new color laboratory. The firm manufactures cellulose acetate molding powder and supplies acetate and other plastic extrusions. Quality control functions have also been transferred to the new laboratory.

The Panelyte Div. of St. Regis Paper Co. plans a substantial expansion program at its industrial laminating plant at Trenton, N. J.; a widening of its manufacturing facilities at its decorative laminating plant at Kalamazoo, Mich.; and a modernization and expansion program at its thermoplastics plants at Cambridge, Ohio; Dexter, Mich.; and Richmond, Ind.

The Panelyte Div. is closing its Chester Packaging Products Div. plant at Yonkers, N. Y., and transferring some of its products and operations to other plants.

Kaye-Tex Mfg. Corp., producers of vinyl sheet and film products, purchased an 11-acre site adjacent to its present main plant and general offices in Yardville, N. J. The tract will be used for plant expansion purposes.

Modern Plastic Machinery Corp. has moved to new quarters at 64 Lakeview Ave., Clinton, N. J. The new facilities triple the size of the previous location at 15 Union St., Lodi, N. J. New production equipment, centralized engineering, manufacturing, and sales are now housed in the 80,000-sq.-ft. plant.

Northwest Plastics Inc., St. Paul, Minn., has built a new 5000-sq.-ft. subsidiary plastics molding factory in Belle Plaine, Minn. Development of the new facility is handled by **Excelsior Plastics Inc.**, a wholly-owned subsidiary of Northwest. Initially, the company has allocated $45,000 for the building and $75,000 for equipment. The new facility, which will specialize in injection molding, will be supervised by **Thomas H. McKinney**, manager of Excelsior.

In addition to the expansion, Northwest is currently replacing all of its injection molding machines with new equipment.

F. J. Stokes Corp. has broken ground for a 50,000-sq.-ft. addition to the present plant at 5500 Tabor Rd., Philadelphia, Pa. The new facilities, which are scheduled for completion by the middle

of 1960, will increase the company's manufacturing and assembly capacity by about 20%, and will also considerably enlarge the amount of space available for product design, sales engineering, and technical service. When fully equipped, the new facilities are expected to increase employment by about 200, bringing the total number of employees over the 1000 mark.

Plas-Tech Equipment Corp. has opened a new plastics research center in Natick, Mass., which will be used for developing improved materials under contract and to accommodate the processing laboratory which is engaged in evaluating the effects of process variables on material properties. It will also house a physical testing laboratory and will be used to evaluate prototype equipment designed by Plas-Tech Equipment Corp.

Mesa Plastics Co. has acquired new facilities at 12270 Nebraska Ave., Los Angeles 25, Calif., which will house the headquarters of the company and a completely new installation of diallyl phthalate compound formulating machinery. The new manufacturing facilities will match those at the old location—11751 Mississippi Ave., Los Angeles—which are still in operation. The company's molding compounds are used in military electronic gear and in other electrical and electronics products.

The Dow Chemical Co. will construct a phenol plant with a capacity of 36 million lb. a year at a location still to be selected in the Pacific Northwest. Operations are scheduled to begin early in 1961. Construction of the plant is the first step in Dow's planned development of an integrated chemical and plastics manufacturing operation in the Northwest.

The company is also building a new plant to manufacture styrene-butadiene latexes at Allyn's Point, Conn., and will expand the capacity for these materials at its Freeport, Texas, facilities.

Dow will also form a wholly owned subsidiary to manufacture polystyrene molding compounds in Greece, with an investment in excess of a million **(To page 244)**

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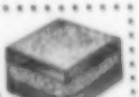
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TROY TUF REINFORCING BLANKETS

THE PLASTISCOPE

(*From page 243*)

dollars. It is expected to be in operation in early 1961. The facility, utilizing imported raw materials, will be the first to produce polystyrene in Greece. The output is scheduled for both the Greek market and for export.

C.S.C.R.-Dow Pty. Ltd. is starting immediate construction on a styrene plant at Altona, Australia. The plant is scheduled for July 1, 1961 start-up.

Federal Tool Corp., Chicago, Ill., completed a new 40,000-sq.-ft., two-story section, which brings the total facilities to 250,000 sq. feet. The company has installed a 300-oz. injection molding machine capable of turning out plastics bathtubs and also producing 55-gal. plastics drums.

The expansion has also increased warehousing space by about 50 percent.

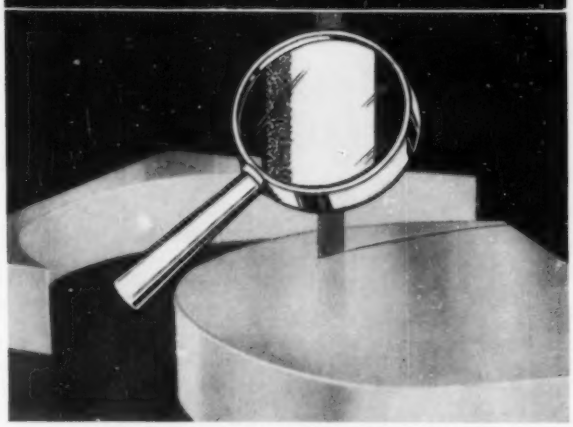
Molded Fiber Glass Body Co. opened a new $250,000 plant for the processing of polyester resin in Ashtabula, Ohio. The plant is expected to save 20% in the cost of polyester resin used in the manufacture of fiber glass products by the five Molded Fiber Glass companies, according to **Robert S. Morrison**, president.

The new facility will produce 20,000 lb. of finished polyester resin per day. Normal production is expected to be 4 to 5 million lb. per year, which is said to be equal to approximately 60% of current needs of the affiliated Molded Fiber Glass companies.

U. S. Industrial Chemicals Co.-International is a new company formed by **U. S. Industrial Chemicals Co.**, division of **National Distillers & Chemical Corp.**, to provide sales assistance to European representatives handling U. S. I.'s Petrothene polyethylene, as well as to provide intensified technical service to European polyethylene processors.

The company, officially incorporated as **Sales & Development Co.** of National Distillers & Chemical Corp. (International) S. A., will be known as **U. S. I.-**

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quarters were opened in Zug, Switzerland, and permanent headquarters and laboratories will be constructed in Baar, Switzerland.

Kenneth E. Cosslett, U. S. I.'s assistant export manager, was named sales manager of the new company. **Howard W. Woodham**, formerly in charge of plant assistance at the company's Tuscola, Ill., polymer service laboratory, will be manager of the laboratory. Approximately 12 people will be employed by the new company early in 1960.

Evanite Plastic Co., a subsidiary of **Evans Pipe Co.**, Ulrichsville, Ohio, purchased a 30-acre industrial site in Leesburg, Fla., for the construction of a $200,000 extrusion facility. Principal products will be 8-in. sewer main and 4- and 6-in. house sewer connections made of PVC.

Evans, a manufacturer of clay pipe, face brick, and allied clay products, recently entered the field of plastics sewer pipe through its Evanite Div. and currently operates a PVC pipe extrusion plant in Carrollton, Ohio. Its facility there includes a $250,000 raw material blending plant.

Glass Yarns & Deeside Fabrics Ltd., an associate company of **Microcell Ltd.**, London, England, is constructing a new plant to increase its output of glass fibers. The plant will eventually be extended over an area of 250,000 square feet.

The Eleonora Div., The Pantasote Co., Passaic, N. J., is increasing its PVC resin capacity by 300% to a total capacity of 45 million lb. annually. Completion of the enlarged facilities, which includes the installation of 12 new PVC resin kettles, is scheduled for the first half of 1960.

The division began operation in 1956 with an initial capacity of 10 to 11 million pounds.

Deceased

Roman C. Brotz, 53, president of **Plastics Engineering Co.**, Sheboygan, Wis., was killed in an auto-[illegible]

Meetings

Plastics groups

Feb. 1: The Society of the Plastics Industry, Inc. (S.P.I.). Symposium on plastics in domestic refrigeration, as part of the Annual National Conference, The American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Baker Hotel, Dallas, Texas.

Feb. 2-4: S.P.I. 15th Reinforced Plastics Div. Conference, Edgewater Beach Hotel, Chicago, Ill.

Mar. 17: Quebec Rubber & Plastics Group, "Weathering of Elastomers," Queens Hotel, Montreal, Quebec.

Mar. 30, 31: The (British) Plastics Institute, Conference on "Polymeric Progress," Wm. Beveridge Hall, London University, London, England.

Other meetings

Jan. 29: Building Research Institute, Plastics study group, Sheraton Atlantic (formerly known as the McAlpin) Hotel, [illegible]

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Paper Co. plans a substantial expansion program at its industrial laminating plant at Trenton, N. J.; a widening of its manufacturing facilities at its decorative laminating plant at Kalamazoo, Mich.; and a modernization and expan- program at its thermoplastics plants at Cambridge, Ohio; Dexter, Mich.; and Richmond, Ind.

The Panelyte Div. is closing its Chester Packaging Products Div. plant at Yonkers, N. Y., and transferring some of its products and operations to other plants.

Kaye-Tex Mfg. Corp., producers of vinyl sheet and film products, purchased an 11-acre site adjacent to its present main plant and general offices in Yardville, N. J. The tract will be used for plant expansion purposes.

Modern Plastic Machinery Corp. has moved to new quarters at 64 Lakeview Ave., Clinton, N. J. The new facilities triple the size of the previous location at 15 Union St., Lodi, N. J. New production equipment, centralized engineering, manufacturing, and sales are now housed in the 80,000-sq.-ft. plant.

Northwest Plastics Inc., St. Paul, Minn., has built a new 5000-sq.-ft. subsidiary plastics molding factory in Belle Plaine, Minn. Development of the new facility is handled by **Excelsior Plastics Inc.**, a wholly-owned subsidiary of Northwest. Initially, the company has allocated $45,000 for the building and $75,000 for equipment. The new facility, which will specialize in injection molding, will be supervised by **Thomas H. McKinney**, manager of Excelsior.

In addition to the expansion, Northwest is currently replacing all of its injection molding machines with new equipment.

F. J. Stokes Corp. has broken ground for a 50,000-sq.-ft. addition to the present plant at 5500 Tabor Rd., Philadelphia, Pa. The new facilities, which are scheduled for completion by the middle

through its Evanite Div. and cur-

gen, Wis., was killed in an auto-

known as the McAlpin Hotel,

and clinical services. When fully equipped, the new facilities are expected to increase employment by about 200, bringing the total number of employees over the 1000 mark.

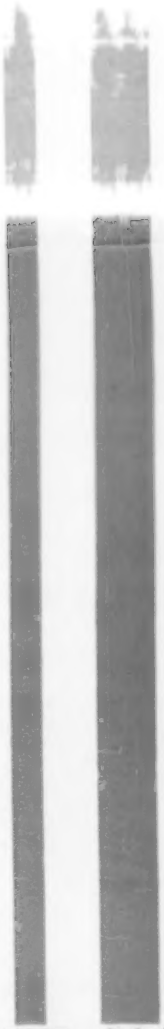
Plas-Tech Equipment Corp. has opened a new plastics research center in Natick, Mass., which will be used for developing improved materials under contract and to accommodate the processing laboratory which is engaged in evaluating the effects of process variables on material properties. It will also house a physical testing laboratory and will be used to evaluate prototype equipment designed by Plas-Tech Equipment Corp.

Mesa Plastics Co. has acquired new facilities at 12270 Nebraska Ave., Los Angeles 25, Calif., which will house the headquarters of the company and a completely new installation of diallyl phthalate compound formulating machinery. The new manufacturing facilities will match those at the old location—11751 Mississippi Ave., Los Angeles—which are still in operation. The company's molding compounds are used in military electronic gear and in other electrical and electronics products.

The Dow Chemical Co. will construct a phenol plant with a capacity of 36 million lb. a year at a location still to be selected in the Pacific Northwest. Operations are scheduled to begin early in 1961. Construction of the plant is the first step in Dow's planned development of an integrated chemical and plastics manufacturing operation in the Northwest.

The company is also building a new plant to manufacture styrene-butadiene latexes at Allyn's Point, Conn., and will expand the capacity for these materials at its Freeport, Texas, facilities.

Dow will also form a wholly owned subsidiary to manufacture polystyrene molding compounds in Greece, with an investment in excess of a million **(To page 244)**



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*Du Pont tradenames

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THE PLASTISCOPE

(*From page 243*)

dollars. It is expected to be in operation in early 1961. The facility, utilizing imported raw materials, will be the first to produce polystyrene in Greece. The output is scheduled for both the Greek market and for export.

C.S.C.R.-Dow Pty. Ltd. is starting immediate construction on a styrene plant at Altona, Australia. The plant is scheduled for July 1, 1961 start-up.

Federal Tool Corp., Chicago, Ill., completed a new 40,000-sq.-ft., two-story section, which brings the total facilities to 250,000 sq. feet. The company has installed a 300-oz. injection molding machine capable of turning out plastics bathtubs and also producing 55-gal. plastics drums.

The expansion has also increased warehousing space by about 50 percent.

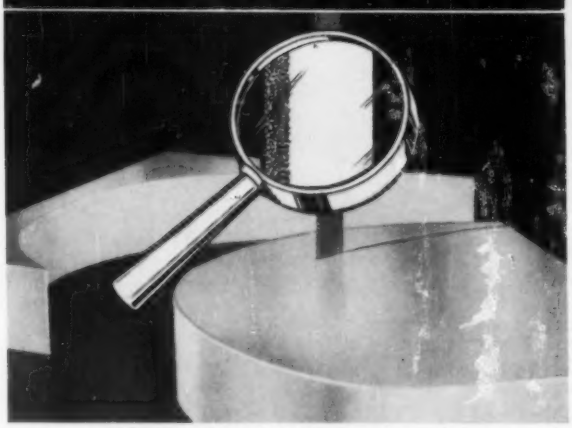
Molded Fiber Glass Body Co. opened a new $250,000 plant for the processing of polyester resin in Ashtabula, Ohio. The plant is expected to save 20% in the cost of polyester resin used in the manufacture of fiber glass products by the five Molded Fiber Glass companies, according to **Robert S. Morrison**, president.

The new facility will produce 20,000 lb. of finished polyester resin per day. Normal production is expected to be 4 to 5 million lb. per year, which is said to be equal to approximately 60% of current needs of the affiliated Molded Fiber Glass companies.

U. S. Industrial Chemicals Co.-International is a new company formed by **U. S. Industrial Chemicals Co.**, division of **National Distillers & Chemical Corp.**, to provide sales assistance to European representatives handling U. S. I.'s Petrothene polyethylene, as well as to provide intensified technical service to European polyethylene processors.

The company, officially incorporated as **Sales & Development Co.** of National Distillers & Chemical Corp. (International) S. A., will be known as **U. S. I.-International.** Temporary head-

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quarters were opened in Zug, Switzerland, and permanent headquarters and laboratories will be constructed in Baar, Switzerland.

Kenneth E. Cosslett, U. S. I.'s assistant export manager, was named sales manager of the new company. **Howard W. Woodham**, formerly in charge of plant assistance at the company's Tuscola, Ill., polymer service laboratory, will be manager of the laboratory. Approximately 12 people will be employed by the new company early in 1960.

Evanite Plastic Co., a subsidiary of **Evans Pipe Co.**, Ulrichsville, Ohio, purchased a 30-acre industrial site in Leesburg, Fla., for the construction of a $200,000 extrusion facility. Principal products will be 8-in. sewer main and 4- and 6-in. house sewer connections made of PVC.

Evans, a manufacturer of clay pipe, face brick, and allied clay products, recently entered the field of plastics sewer pipe through its Evanite Div. and currently operates a PVC pipe extrusion plant in Carrollton, Ohio. Its facility there includes a $250,000 raw material blending plant.

Glass Yarns & Deeside Fabrics Ltd., an associate company of **Microcell Ltd.**, London, England, is constructing a new plant to increase its output of glass fibers. The plant will eventually be extended over an area of 250,000 square feet.

The Eleonora Div., The Pantasote Co., Passaic, N. J., is increasing its PVC resin capacity by 300% to a total capacity of 45 million lb. annually. Completion of the enlarged facilities, which includes the installation of 12 new PVC resin kettles, is scheduled for the first half of 1960.

The division began operation in 1956 with an initial capacity of 10 to 11 million pounds.

Deceased

Roman C. Brotz, 53, president of **Plastics Engineering Co.**, Sheboygan, Wis., was killed in an automobile accident, November 29.

Meetings

Plastics groups

Feb. 1: The Society of the Plastics Industry, Inc. (S.P.I.). Symposium on plastics in domestic refrigeration, as part of the Annual National Conference, The American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Baker Hotel, Dallas, Texas.

Feb. 2-4: S.P.I. 15th Reinforced Plastics Div. Conference, Edgewater Beach Hotel, Chicago, Ill.

Mar. 17: Quebec Rubber & Plastics Group, "Weathering of Elastomers," Queens Hotel, Montreal, Quebec.

Mar. 30, 31: The (British) Plastics Institute, Conference on "Polymeric Progress," Wm. Beveridge Hall, London University, London, England.

Other meetings

Jan. 20: Building Research Institute, Plastics study group, Sheraton Atlantic (formerly known as the McAlpin) Hotel, New York, N. Y.—**End**

COMPANIES . . . PEOPLE

Appointments, promotions, and relocations in the plastics industry.

Hooker Chemical Corp. is establishing new corporate headquarters at 666 Fifth Ave., New York, N. Y., about March 1, 1960. The following officers will be transferred from their present headquarters: **Thomas E. Moffitt**, pres.; **R. Wolcott Hooker, Frank W. Dennis,** and **Robert E. Wilkin**, all sr. VP's; **Ansley Wilcox II**, VP, secy., and gen. counsel; **Thomas F. Willers,** VP, whose executive duties have recently been expanded to include responsibility for Eastern Chemical, Phosphorus, and Durez Plastics Divs., and for corporate engineering; **F. Leonard Bryant**, VP responsible for research, marketing, and gen. development; **Charles C. Hornbostel,** controller; and **Edward W. Mathias,** treas.

The New York dist. sales offices of the Eastern, Chemical, Durez Plastics, and Phosphorus Divs. will move to the new location from the Lincoln Bldg., 60 E. 42nd St., New York, N. Y.

John S. Coey named to succeed Mr. Willers as gen. mgr.—Eastern Chemical Div. **James W. Ferguson** appointed sales mgr. of Durez Plastics Div., succeeding **Alfred W. Hanmer**, who died recently.

Monsanto Chemical Co., Plastics Div.: Stuart H. Rider promoted from research section leader to asst. research dir. at Springfield, Mass. **Harold D. Woodmansee** named div. coordinator of sales warehousing, Springfield. He is succeeded as mgr. of the Cleveland, Ohio sales office by **Daniel R. Goodfellow**, former asst. dist. mgr. Newly hired personnel at Springfield include **L. John Berggren** and **Thomas E. Daly Jr.**—engineering dept., and **Wilbur A. Brown**—production dept.

Newell H. Goodwin and **William H. Burke** joined the mfg. dept., and **Wallace L. Maurer** and **Earle D. Moore** joined the engineering dept. at Texas City, Texas.

The Dow Chemical Co.—Midland Div.: Macauley Whiting promoted from mgr.—service depts. to gen. mgr. of the div., succeeding **Dr. William H. Schuette**, who died.

Dow Chemical International Ltd. S. A.: Joseph Eveland, formerly head of the international section of Dow's plastics tech. service, named plastics sales mgr. for the European area. He will be located at the Zurich, Switzerland hq. **Philip J. Meeks** succeeds Mr. Eveland.

Dow Chemical Co. (U. K.) Ltd. is the new name of **Dobeckmun Britain Ltd.**, Dow's British subsidiary, which has also expanded its activities and will take over direct sale of Dow-produced packaging films, such as Trycite polystyrene film; saran wrap vinyl-vinylidene chloride copolymer film; and polyethylene film. The company will also supervise the sale of Dow U. S. and Canadian-produced plastics and industrial chemicals in the United Kingdom. **R. W. Greeff & Co. Ltd.** will continue as principal distributor, handling chemicals and coatings raw materials. **British Resin Products Ltd.** is the distributor for plastics molding materials. **Robert H. Gregory** remains managing dir. of the British subsidiary.

Esso Standard Oil Co. elected **O. V. Tracy** to succeed **William Naden** as pres. From 1952 until 1958, Mr. Tracy was pres. of **Enjay Co. Inc.**, Esso's petrochemicals marketing affiliate. He has been closely associated with the development of chemicals from petroleum since he joined Esso Standard in 1930. He has been a dir. since 1954 and a VP since 1956. His responsibilities on the Esso board have included all of the company's refining and petrochemicals operations.



O. V. Tracy

Robert H. Scholl succeeds **E. Duer Reeves** as exec. VP. Mr. Naden is now exec. VP and dir. of Esso's new **Humble Oil & Refining Co.;** Mr. Reeves is a VP and dir. of the same company.

The Society of the Plastics Industry Inc.—Epoxy Resin Formulators Div.: The following officers were reelected to serve for another year: **L. R. Miller, Rexolin Inc.**, Santa Monica, Calif. — chrmn.; **John Delmonte, Furane Plastics Inc.**, Los Angeles, Calif.—1st v-chrmn.; and **Donald Roon, Houghton Laboratories Inc.**, Olean, N. Y.—2nd v-chrmn.

Wallace & Tiernan Inc.—Harchem Div.: William C. Wiley appointed product development mgr. **Wallace E. Riffelmacher** named sales rep. for chemicals and plasticizers in the New York and New England area. **Raymond C. Wolfert** appointed sales rep. for plasticizers in the Mid-west.

St. Regis Paper Co.: John E. Murray appointed asst. to the export mgr., Panelyte Div.'s export dept. **Walter H. Christiansen** replaces Mr. Murray as N. Y. decorative laminate distributor salesman. **Frederick M. Tyson** joined the decorative Panelyte sales organization as architectural sales rep. **Wendall Trest** transferred from the Memphis, Tenn. to the Kalamazoo, Mich. sales office. **Robert A. Hayes** is the new decorative Panelyte salesman in the Memphis sales office.

The company opened a decorative Panelyte sales office at 126 N. Main St., High Point, N. C. **Charles M. Jackson,** formerly based at Bethesda, Md., heads the new office.

Spencer Chemical Co. moved its New York, N. Y. dist. office from 500 Fifth Ave. to 575 Lexington Ave.

Davis-Standard, Div. of Franklin Research Corp., Mystic, Conn.: **Rodney H. Morrison** appointed sales engineer. Michigan has been added to the territory of **C. J. Beringer Co.**, 5667 Milwaukee Ave., Chicago, Ill. **John Wheeler Jr.**, sales engineer, will continue to service wire insulating accounts in the area.

Amos-Burke Plastics Inc. is the new name of the recently incorporated **Burke Plastics Molding & Mfg. Corp.**, Syracuse, N. Y. **Dean W. Burke** is pres. and **Alan Amos** is secy-treas. The company has purchased additional injection molding machines and vacuum forming equipment, and is increasing facilities for industrial molded parts.

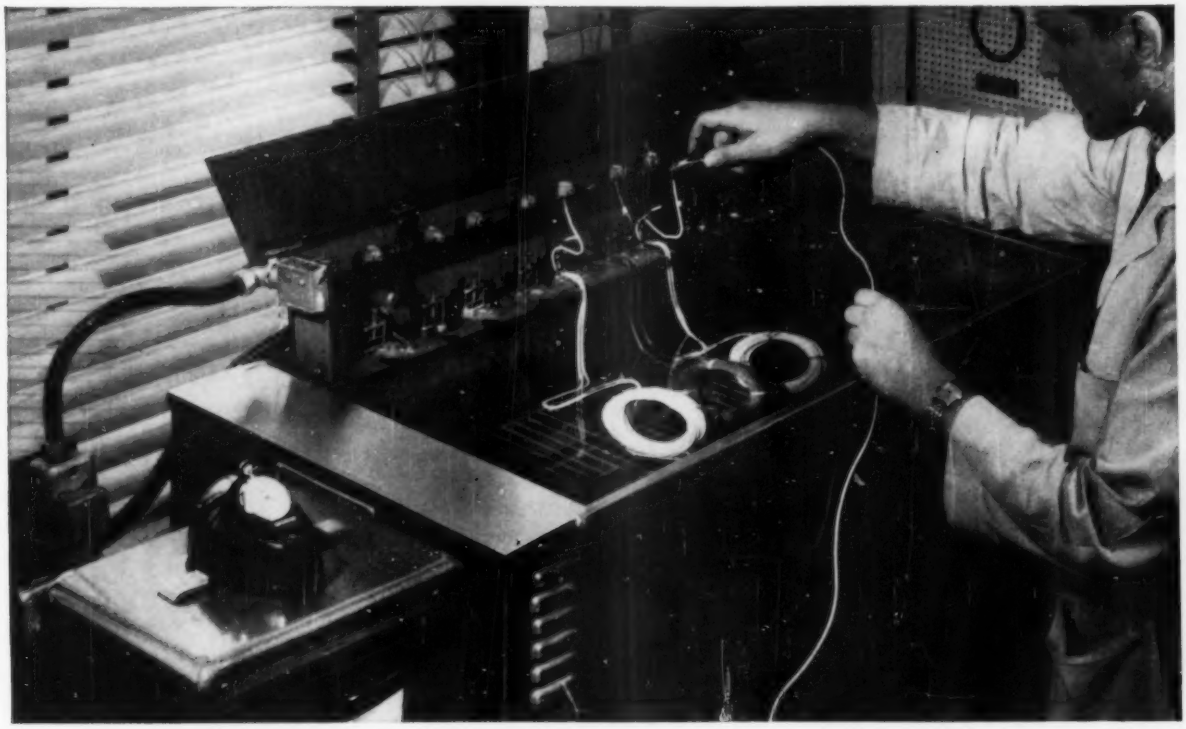
U. S. Industrial Chemicals Co., Div. of National Distillers & Chemical Corp.: Albert C. Brooks named mgr. of the Baltimore, Md. sales div. succeeding **James F. Whitescarver,** who retired. **Roy A. Parker** promoted from mgr. of the Kansas City, Mo. sales office to mgr. of the sales div. **Joseph G. Longstreth** appointed mgr. —St. Louis, Mo. sales office, and **John A. Putnam** named mgr. of the Atlanta, Ga. office.

George B. Koch Jr. named advertising mgr. of industrial and commercial products for **The B. F. Goodrich Co.**, Akron, Ohio. His assignment fills a position recently created by centralization of administration for all national advertising by BFG and its nine divs. Mr. Koch joined **B. F. Goodrich Chemical Co.** in 1946 as a sales promotion man. He became advertising mgr. in 1948 and served in that capacity until 1950, when he was given a special assignment of organizing an agricultural chemicals sales branch.



G. B. Koch Jr.

Randolph H. Barnard resigned as pres. of **Johns-Manville Fiber Glass Inc.**, a mfg. subsidiary of **Johns-Manville Corp.,** **(To page 249)**



Immersion test proves DYTHAL stabilizer gives top performance to 75°C THW vinyls.

How DYTHAL® stabilizer is helping the electrical industry develop a new insulation, 75°C THW

. . . improved vinyl stocks will lift rating of building wire by 15°C

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In compounds that meet these high standards, a National Lead Company stabilizer, DYTHAL, is proving to be an exceptional product.

Tests . . . confirmed by leading insulation producers . . . show that DYTHAL stabilizer is by far the most compatible and the most efficient stabilizer to use in stocks such as these. It confers superior heat stability. It promotes excellent extrusion properties. It does not affect sensitive plasticizers.

What's more, DYTHAL stabilizer is well adapted to an electrical compound. It disperses uniformly. It does not produce gassing or porosity. It is highly resistant to water extraction and to moisture pick-up.

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- TRIBASE* and TRIBASE-E* stabilizers boost heat resistance of 60°C 7, TW, SPT stocks at low cost.
- LECTRO* 77 stabilizer meets requirements for primary insulations up through 80°C types.
- LECTRO* 78 stabilizer improves special high-temperature stocks including flexibles, rigids, electrical-grade plastinols.
- DS-207® stabilizer-lubricant improves heat resistance, extrusion characteristics, water resistance of vinyl.

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They know that Plastolein 9058 DOZ is the time-tested standard of the low temperature plasticizer field . . . that it provides the kind of low temperature flexibility *that stays in* their vinyls even after prolonged exposure to summer heat.

And more and more producers are utilizing the unusual capabilities of another Emery plasticizer, Plastolein 9078 LT, which approximates 9058 performance, but at a much lower price.

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Organic Chemical Sales Department
Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio
Vopcolene Division, Los Angeles
Emery Industries (Canada), London, Ontario
Export Department, Cincinnati

COMPANIES...PEOPLE

(*From page 246*)

Toledo, Ohio. He intends to continue to advise J-M as a consultant on fibrous glass. **Francis H. May Jr.**, VP, has been elevated to full responsibility for administration.

Dr. T. Robert Santelli, previously chief of plastics research and development of the General Research Dept. of **Owens-Illinois Glass Co.**, named asst. dir. of research. He succeeds **Robert T. Wallace**, who joined O-I's International Div.

Donald R. Williams, pres. of **Chippewa Plastics Co.**, a div. of the **Rexall Drug & Chemical Co.**, resigned his post.

Louis Oleari named asst. mgr., **Latin America-Asia Div., Calif. Chemical International, Inc.**, subsidiary of **Standard Oil of Calif.**, which markets phthalic anhydride, phenol, and other chemicals for Oronite Chemical Co. abroad. The Div. territory includes Japan, Hong Kong, Australia, Thailand, India, and other Far East markets as well as Mexico, Central and South America and the Caribbean countries.

Prior to his new appointment, Mr. Oleari was dist. sales mgr. of Oronite Chemical Co. for the southern section of the U. S., with headquarters in Houston, Texas. His new office will be at the company's headquarters in San Francisco, Calif.

Victor P. Buell named VP of marketing for **Archer-Daniels-Midland Co.**, Minneapolis, Minn. He was previously mgr. of the marketing div. of Hoover Co., appliance mfr.

Morrison M. Bump, elected exec. VP of **United Carbon Co. Inc.** He will continue as dir.-marketing of **United Carbon Co.**, the parent firm, suppliers of carbon black.

Dr. Charles J. Chaban elected VP for research of **The Landers Corp.**, Toledo, Ohio mfr. of Versilan, vinyl upholstery fabric, and Ventilan, air-permeable vinyl upholstery.

Joseph P. Palumbo appointed mgr. of the plastics industry div. of **Nuodex Products Co.**, Div. of **Heyden Newport Chemical Corp.**, Elizabeth, N. J. He was formerly product sales mgr. for organic peroxide catalysts and accelerators.

The plastics industry div. was created because of the growth of the company's line of vinyl stabilizers, organic peroxide catalysts, accelerators, and fungicides.

Norman Riley named a VP of **National Starch & Chemical Co. (Canada) Ltd.** He will head the Toronto div. and assume responsibilities for the **(To page 250)**

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COMPANIES...PEOPLE

(*From page 249*)

Canadian company. He will be succeeded as mgr. of the Montreal div. by **Gerald W. Burgoyne,** formerly sales mgr. of that div.

Morton H. Sinks named dist. mgr. for the Midwest area for **Bex Industries Inc.,** New York, N. Y. mfr. of custom-made bacteriostats for the plastics industry. His office is at 407 Caxton Bldg., Cleveland, Ohio.

David Edwin Cordier, formerly tech. dir. of Carwin Polymer Products, North Haven, Conn., named tech. dir. of **Mesa Plastics Co.,** Los Angeles, Calif. formulators of diallyl phthalate molding compounds.

Dr. Walter H. Prahl, dir. of phenol R & D, **Durez Plastics Div., Hooker Chemical Corp.,** N. Tonawanda, N. Y., received the 8th Annual Professional Achievement Award of the Western New York Section, **American Institute of Chemical Engineers,** in recognition of his pioneering work in the development of the "Raschig phenol process."

H. R. Bishop named mgr., Middle Atlantic and Southern sales dist., for **W. R. Grace & Co.,** Polymer Chemicals Div. He will have his office in Clifton, N. J.

Harold L. Kast joined **Tech-Art Plastics Co.,** Morristown, N. J., as product engineer, thermosetting products. Prior to coming to Tech-Art, he was plant mgr. for Valley Molding Co., Boonton, N. J.

William A. Gallup appointed sr. research chemist in the plastics div. of **Diamond Alkali Co.'s** research dept., Painesville, Ohio.

James A. Gregg appointed sales engineering rep. for **Swedlow Inc.** in Arlington, Texas, to serve the states of New Mexico, Colo., Okla., Kan., and Texas.

Al Palais named Chicago, Ill. sales rep. for **G. T. Schjeldahl Co.,** Northfield, Minn. mfr. of air-supported plastic buildings called Schjeldomes, tapes and adhesives, and custom plastic laminations.

Robert W. Pollock appointed chief of tech. liaison of CTL, Cincinnati, Ohio producer of high temperature resistant plastics, and builders of missile nose cones.

Joseph C. Ryan named Western sales mgr. for **Lenox Plastics Inc.,** St. Louis, Mo.

E. E. Griesser appointed mgr. of **Union Carbide Technical Service Laboratory,** to be located in Geneva, Switzerland. The new laboratory will be under the supervision of **Union Carbide Europa S. A.,** which is an affiliate of **Union Carbide Corp.**

Saul Skoler named gen. mgr. of **Plastics Industrial Products Inc.,** Peabody, Mass. custom mfr. of extruded plastic products.

M. Lawrence Kaufmann appointed sales mgr. of **Brilhart Plastics Sales Corp.,** precision custom molder. He replaces **Thomas C. Ackerly,** who recently resigned.

W. G. Potts named asst. mgr., extruder sales div. of **National Rubber Machinery Co.,** Akron, Ohio.

New reps.

Harry A. Baumstark & Co., 6801 Arsenal St., St. Louis 9, Mo., appointed sales rep. for **United Ultramarine & Chemical Co. Inc.,** in eastern Mo., northern Ark., and southern Ill. . . . **Tumb-L-Matic Inc.,** mfr. of tumbling equipment appointed **Thomson & Willett Co.,** Haverford, Pa., rep. in eastern Pa., southern N. J., Del., and Md.; and **Joseph Upton Jr.,** rep. in metropolitan N. Y., northern N. J., and the Hudson Valley section. . . .

Formica Corp., subsidiary of **American Cyanamid Co.,** appointed the following distributors for Flakeboard: **Mechanics Lumber Co.,** 22 Stanton St., New York, N. Y., metropolitan N. Y.; **Karjams Inc.,** W. Hempstead, N. Y., services the Long Island area; **Fabricators Supp'y Co.,** Newark, N. J., and **Mechanics Lumber Corp. of N. J.,** S. Kearny, N. J., covers northern N. J.; **Fessenden Hall, 3rd & Norris Sts.,** Philadelphia, Pa., greater Philadelphia. . . .

Harter's Distributing Co., 11821 Vose St., N. Hollywood, Calif., and **Bldg. Products Co.,** Oakdale St., Jackson, Miss., named distributors for Formica bldg. products . . . **St. Germain Bros. Inc.,** 5 W. 1st St., Duluth 2, Minn., and **Wrenn Lumber Corp.,** 203 Naval Reserve Ave., Roanoke, Va., named distributors for Formica laminates and adhesives. . . .

International Sales Corp., 1230 Westlake Ave. N., Seattle, Wash., named rep. for **Marblette Corp.,** Long Island City, N. Y., for its line of Marblette phenolic resins; Maraset plastics tooling and electronics insulating epoxy resins and epoxy coatings and adhesives; Maraglas water-clear epoxy resin; and Marafoam rigid urethane foam . . . **Haylett O'Neill & Son,** Houston, Texas, appointed rep. for **Sterling Inc.,** Milwaukee, Wis. mfr. of temperature control units for the plastic molding and die casting industries. . . .

Donald McKay Smith Inc., 966 Hanna Bldg., Cleveland, Ohio, named exclusive distributor by J. M. Huber Corp. for its line of kaolin clay extenders and Zeolex synthetic silicate pigments to the plastics industry . . . **Filon Plastics Corp.,** El Segundo, Calif., mfr. of fibrous glass

reinforced panels, appointed the following reps.: **Lumberman's Supply Inc.**, Madison, Wis.; **Georgia-Pacific Corp.**, Lafayette, La.; and **McNeil Co.**, Kingsport, Tenn. . . .

Landers-Segal Color Co., Brooklyn, N. Y., appointed the following sales reps. to have charge of its Lansco dry colors, water dispersions, and flushed colors to the mfg. industries: **T. L. Peterson Co.**, 3049 E. Grand Blvd., Detroit 2, for Mich.; and **T. H. Cushman Co.**, 339 Auburn St. Auburndale 66, Mass., to cover the New England area. . . .

Thoreson-McCosh Inc. appointed the following reps. to handle its line of hopper-dryers, hopper-loaders, and shear-way grinder units: **Oak Engineering Co. Inc.**, 110 Monmouth St., Gloucester City, N. J., for Del., Md., D. C., eastern Pa., upper Va., and southern N. J.; **Standard Tool Co.**, 507 5th Ave., New York, N. Y., for metropolitan New York and the northern N. J. area. Philan's Inc., 390 Rockaway Ave., Brooklyn, N. Y., named distributor for Clopay Corp., Cincinnati, Ohio, mfr. of window shades and plastic yard goods.

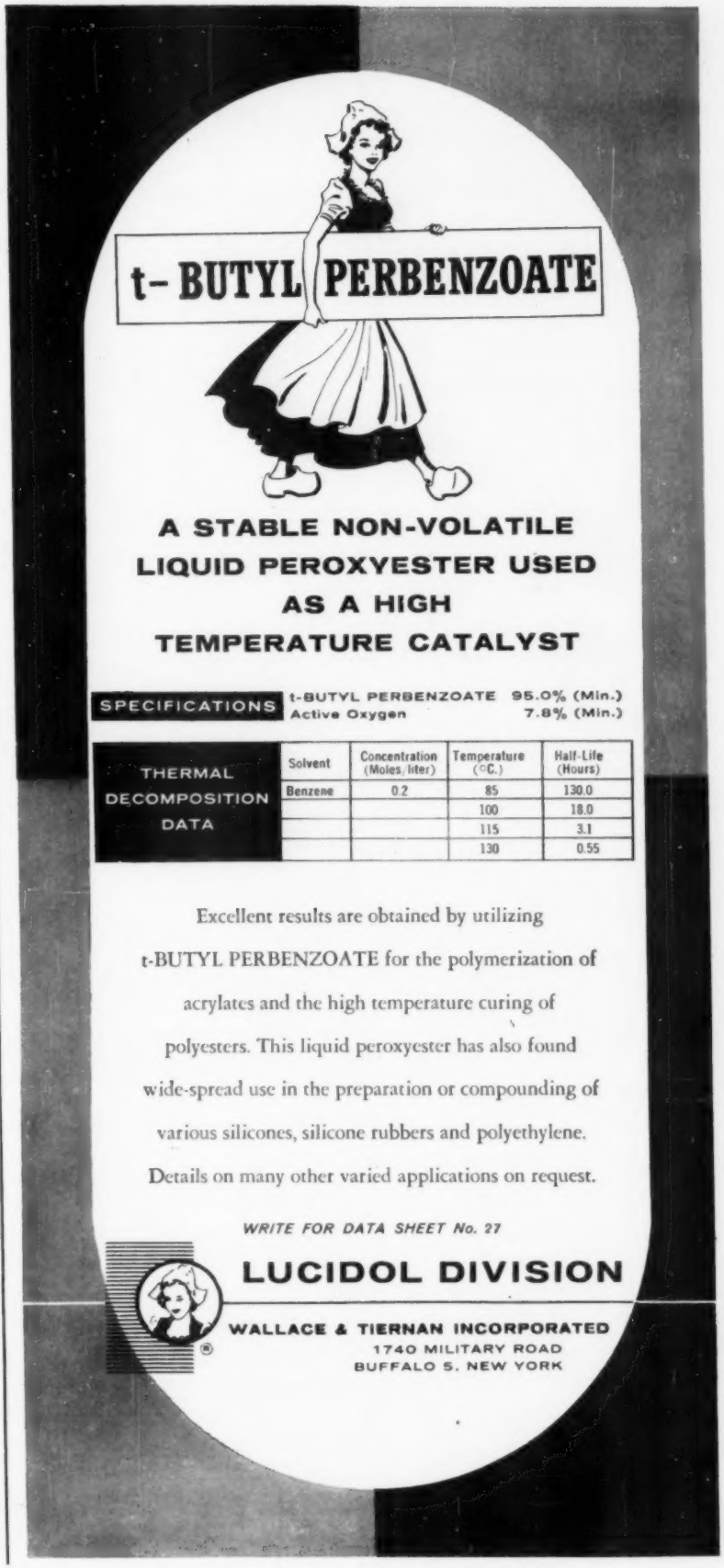
Corrections

Modern Plastics Encyclopedia Issue for 1960. **National Polychemicals Inc.**, Wilmington, Mass., was inadvertently omitted from the Plastics Properties, Coating Resins, Laminating Resins, and Adhesives charts. The company manufactures a complete line of phenolic and urea resins in all available forms for reinforcing, compounding, impregnating, coating, and bonding for such outlets as plywood, rubber, furniture, hardboard, particle board, decorative and industrial laminating, paper impregnation, and beater treatment. These groups of resins include all modifications, such as resorcinol, cresol, xylenol, and other types. Tradename for the phenolic resins is Poly-Phen; trade name for urea resins is Poly-Ria.

On the Thermosets half of the Plastics Properties Chart, **Plumb Chemical Corp.**, 4837 James St., Philadelphia 37, Pa., should be listed as a supplier of Polyester Molding Materials. The company tradename for these molding compounds is Fibercore.

In the Foamed Plastics Chart, beginning on p. 513, **United Cork Companies, Uni-Crest Div.**, 29 Central Ave., Kearny, N. J., should be listed as a supplier of expandable polystyrene beads. Tradename for the product is Uni-Crest.

"Reinforcing action of glass and organic fibers in epoxy laminates" (MPI, Nov. 1959, p. 143): Column 2, line 11, p. 145—should read "non reinforced;" Table II, p. 145—Variance of ultimate strain of ED should read "3.57%;" col. 2, line 20, p. 152—should read "$\varepsilon_0 = 0.006$"; col 3, Eq. 1, line 4, p. 198—should read "10^{-1} in.;" Ref. 2, p. 200—should read "1957."—End



CLASSIFIED ADVERTISEMENTS

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and Equipment for sale

FOR SALE: Ovens, Grinders, Powder Mixers, Injection Molding Machine 1 oz. to 60 ozs. never used and used. Two-head Bottle Blowing Machine. Acme Machinery & Mfg. Co., Inc., 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900. 102 Grove Street, Worcester, Mass. PLeasant 7-7747. 5222 W. North Ave., Chicago, Ill. TUxedo 9-1328.

FOR SALE: 6 New Farrell Birmingham 14" x 30" two roll mills. Watson Stillman 240 ton, ten 24" x 56" platens. Baldwin-Southwark 200 ton semi-automatic transfer molding press. Baldwin Southwark 150 ton downstroke, 48" x 40" platens. French Oil 120 ton self-contained. 120 ton upstroke, 29"x 21" platens, 12" stroke. 60 Ton Farquhar 50" x 50" platens, 30" stroke. 50 Ton Birdsboro 24" x 20" platens. 30 ton Birdsboro 21" x 14" platens. Hydraulic pumps and accumulators. Unused ¾ oz. Bench Model Injection Machines. Van Dorn 1 oz. and 2 oz. Other sizes to 100 oz. Baker Perkins and Day jacketed mixers. Plastic Grinders. Seco 6" x 12" and 8" x 16" mills and calenders. New ¾" Plastic Extruder and other sizes up to 6". Stokes BB2 and RD3 Rotary-Preform Tablet machines, also single punch ½" to 4". Partial listing. We buy your surplus machinery. Stein Equipment Co., 107-8th St., Brooklyn 15, N.Y.

MOST MODERN PACKAGING AND PROCESSING MACHINERY — AVAILABLE AT GREAT SAVINGS: Baker Perkins JNM-2, 50 gal. Stainless Steel Heavy Duty Double Arm Mixer with Hydraulic Tilt. Baker Perkins, W & P and Day Double Arm Steam Jacketed Heavy Duty Mixers—50, 75, 100, 150 and 200 gal. capacities. Day 2½ gal. MDA Mogul D.A. Vac Experimental Mixer. Fitzpatrick Models D, D-6 and K Stainless Steel Comminuters. Werner & Pfleiderer 3,000 gal. and 3,500 gal. Jacketed Double Arm Mixers. Stokes Models R, RD-1 and DD2 and Eureka Tablet Machines. Colton 2RP, 3RP, 3B, 5½ T Tablet Machines. Mikro Pulverizers, Models 1SH, 2TH, 3TH and 4TH. Day, Robinson 50 to 10,000 lbs. Dry Powder Mixers. Jacketed and Unjacketed. Package Machinery, Hayssen, Scandia, Wrap King, Campbell, Miller Wrappers. Pneumatic Scale Automatic Carton Feeder, Bottom Sealer, Wax Liner, Top Sealer with Interconnecting Conveyors. Pneumatic Scale Tite Wrap. Standard Knapp, A-B-C, Ferguson Carton Sealers. Union Standard Equipment Company, 318 Lafayette Street, New York 12, N. Y. Phone: CAnal 6-5334.

SAVE ON FIRST CLASS EQUIPMENT: Banbury Model B Mixer, 25 HP. Baker Perkins Mixers to 300 gal. Falcon Ribbon Blenders; all sz. F-B 2 Roll Mills; 14" x 30" Extruders: Royle 2"; 3"; NRM 1½"; Patterson-Kelly 150 cu.ft. Conical Blenders; others to 300 cu.ft. 250 ton self-cont. Laminate Press. 3 French-Oil Presses 10" Ram. Dunning & Boschert Presses 12" Ram; Stewart-Bolling 22" Ram; 36" x 36" 6 Southwark Presses; 14" Ram; 30" x 36" Strokes, Kux, Colton Pre-Form Presses Hammer Mills, Cutters, Sifters etc. Rental Purchase Plan. First Machinery Corporation, 209 Tenth St. Bklyn. 15, N.Y., STerling 8-4672.

FOR SALE: 1—Baker Perkins 100 gal. Sigma Blade Mixer; 1—Baker Perkins size 16 TRM, 150 gal. double arm, Vacuum Mixer; 1—Rotary Cutter; 1—Kent 6" x 14" three roll Mill; 6—Stokes Model DD2, DS3, D3, and B2 Rotary Preform Presses; 4—Stokes Model "R" single punch Preform Presses. Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment. Brill Equipment Co., 37 Jabez St., Newark 5, N. J. Tel. No. Market 3-7420.

FOR SALE: Stainless reactors or resin Kettles: 3500, 2200, 1900, 1300, 1000, 750, 500, 350 gal., jktd. and agit. Baker-Perkins dbl. arm mixers: 200, 100, 50 gal. capacity, steel or stainless. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE—2-MPM 1¼" and 2½" electrically heated plastics extruders; 1—Baldwin Southwark 150 ton self-contained compression molding press; 1—Farrel Birmingham 22" x 60" 2 roll mill, 150 HP; 2—Cumberland 7" stair step dicers, stainless steel; 2—jacketed steel ribbon blenders, 70 and 25 cu.ft.; also mixers, presses, preformers, etc. Chemical & Process Machinery Corp., 52 9th Street, Brooklyn 15, N.Y., HY 9-7200.

NEW YEAR SPECIALS:
Two 28 oz. Watson-Stillman injection molding machines. Late type equipment. Can be inspected under power. 12 oz. Watson-Stillman and 8 oz. Reed Prentice injection molding machines, inspect under power. Top Cap Rubber and Plastic Mills. 26" x 84"; 22" x 60"; 16" x 42"; and 10" x 24" sizes. All units self-contained with motor and reduction drives. Real Values! 75 Ton Elmes fully self-contained up-moving hydraulic press. Fitted with upper and lower steam platens 36" x 20". Hi-Lo pumping systems. 250 Ton Southwark multi-opening hydraulic press. Equipped with four 60" x 48" steam heated platens. Complete with conveyor and lift tables. 1,000 ton hydraulic laminating press. 10 openings with eleven 37" x 37" steam platens. Plastic Extruders: NRM 1½" and 2½"—Royle 3¼"—Hartig 3¼"—Adamson 6"—Farrel 3". Also a complete line of blenders, mixers, scrap cutters and other equipment for the plastic and rubber industry. What Do You Need? What Do You Want? We Will Finance. Johnson Machinery Company, 683 Frelinghuysen Ave., Newark, New Jersey, BIgelow 8-2500.

FOR SALE: Fellows 8 oz. molding machine, new in 1955. Low pressure closing. Leeds & Northrup instruments. Has been well maintained and is in excellent running condition. May be seen in operation. Sterling Plastics Co., 1140 Commerce Ave., Union, New Jersey.

FOR SALE: 75 ton 14" x 14" Stewart-Bolling Press—150 ton 13" x 14" Southwark Press—30 ton 8" x 8" Burroughs Press—No. 1 Famco Arbor Press—Carver Laboratory Presses and other to 75 ton—Double Solenoid Four-way Valves ¾" 3000 psi—Cam-operated Valves ¾" 3000 psi—miscellaneous gauges, high pressure valves and hydraulic pipe fittings. Plastic Machinery Exchange, 426 Essex Ave., Boonton, N. J., Deerfield 4-1615.

FOR SALE: Dismantling 1938 model 10 Reed-Prentice 4 oz. injection molding machine. All parts including 220 V. Microflex timers and G. E. solonoids. Howell 15 H.P. 220-440 V. motor, heating cylinder, nozzles and hydraulic cylinders. Write Shreve Molded Products, Inc., 4105 Simon Road, Youngstown 1, Ohio.

POWDER BLENDERS: 10,000 lbs. Lab. Mill 6 x 16. 1 Farrel 16 x 36 Mill 30 HP motor & drive. Baker Perkins 150 gal. 2 arm, 40 HP; 100 gal. 2 arm, 50 HP, S. S. jacketed, vacuum, hydr tilt. Stokes 3 DDS2. 1 S. 1 T 6 R's. Calender 6 Roll 5" x 12". 1 1000 ton Hobbing Press. Ball Mills Machinecraft Corp., Newark 5, N.J. Mitchell 2-7634.

FIFTY LATTNER BOILER dealers throughout the country have used and like new automatic steam boilers for sale. Small sizes ½ to 35 H.P. Gas, oil or electric fired. Write for name of dealer near you. Lattner Mfg. Co. Cedar Rapids, Ia.

FOR SALE: 4 Lester Injection Molding Machnies—Model L 2½—12 oz.—1947—Good Condition. We are going out of the molding business and will sell these machines at a very low price. Reply Box 6300, Modern Plastics.

TWO—1954 REED PRENTICE PRESSES, model 10D-12 oz.: with instruments, controls, etc., for immediate removal. Can be seen in operation. Excellent condition. Being replaced with automatic equipment. Rogers Plastic Corporation, West Warren, Massachusetts, HEmlock 6-7744.

Machinery wanted

WANTED TO BUY: Used injection molding machines, oven, granulators. One machine or complete plant. Acme Machinery & Mfg. Co. Inc., 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900, 102 Grove Street, Worcester, Mass. PLeasant 7-7747, 5222 West North St., Chicago, Illinois, TUxedo 9-1328.

WANTED: 3½ inch plastic extruder with L/D ratio of 20:1; vented, with adjustable pressure valve, if possible. Also electrically heated "T" die and take-off equipment for 48 in. sheet. Also used Autovac vacuum former with minimum molding area 2 by 3 feet. Reply Segall, 16 de Septiembre 49, Mexico, 1 D.F.

WANTED: Used Lester injection molding machine, Model L-2-12, not more than eight years old. Security Plastics, Inc., 4295 East 11th Avenue, Hialeah, Florida. Phone: MU 8-8811.

WANTED: One used, clean injection molding press up to 3 oz. in capacity for laboratory purposes. Cannot use lever-operated machine. Write advising model, make, age, name, delivery and price. Reply Box 6301, Modern Plastics.

Materials for sale

FOR SALE: 40,000 lbs. Black Repellitized Polypropylene. 29¢ per lb. Other colors also available. Reply Box 6314, Modern Plastics.

MATERIALS FOR SALE: Modified and crystal P/S, Propylene and Polyethylene in natural and colors. All densities and indices for injection, extrusion and blow molding. Amco Plastic Processors, 183-02 Liberty Avenue, Jamaica 12, New York, AXtel 1-5550.

FOR SALE: Methyl Methacrylate Monomer available in large quantities, Reply Box 6302, Modern Plastics.

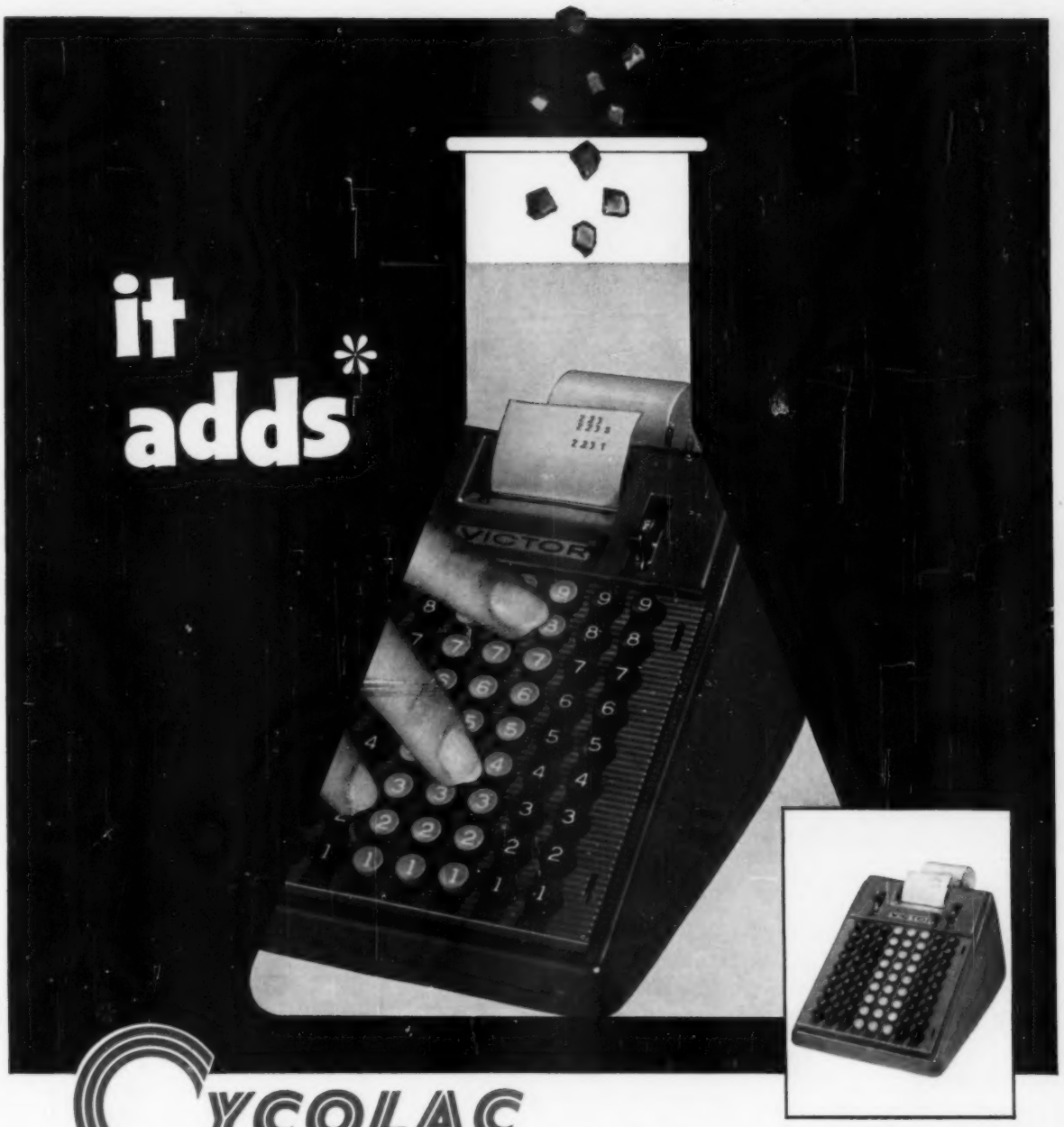
FOR SALE: All Types Of Nylon Scrap. Reply Box 6303, Modern Plastics.

Materials wanted

WANTED: Plastic of all kinds—virgin, reground, lumps, sheet and reject parts. Highest prices paid for Styrene, Polyethylene, Acetate, Nylon, Vinyl, etc. We can also supply virgin & reground materials at tremendous savings. Address your inquiries to: Gold-Mark Plastics Compounds, Inc., 4-05 26th Ave., Long Island City 2, N. Y. RAvenswood 1-0880.

WANTED: All types of plastic scrap and surplus inventories such as: styrenes, butyrates; acetates, acrylics, and polyethylenes in any form. Write, Wire or Phone Collect. HUmboldt 1811. Phillip Shuman & Sons, 15-33 Goethe Street, Buffalo 6, New York.

(Continued on page 254)



CYCOLAC®

THE BORG-WARNER PLASTIC THAT'S TOUGH, HARD, AND RIGID

The Victor Adding Machine Company was looking for a machine housing that was practically indestructible. It had to withstand hard blows, staining, fading, and wear.

CYCOLAC, the tough, hard, rigid ABS plastic from Borg-Warner, proved it could do the job—and economically, too! It was given every test—even thrown down stairs!—yet it came through like a champion. Every day more leading manufacturers discover how much CYCOLAC can improve their products.

Why not find out what it can do for **yours?**

CYCOLAC *Better in more ways than any other plastic*

MARBON CHEMICAL DIVISION **BORG-WARNER**
WASHINGTON WEST VIRGINIA

(*Continued from page 252*)

GET THE TOP MONEY FOR PLASTIC SCRAP: Now paying top prices for all thermoplastic scrap. Wanted: polystyrene, cellulose acetate, vinyl, polyethylene, butyrate, acrylic, nylon. All types and forms including rejects and obsolete molding powders. Fast action wherever you are located. WRITE, WIRE TODAY! Reply Box 6304, Modern Plastics.

WANTED: Plastic scrap. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl. George Woloch, Inc., 514 West 24th Street, New York 11, N. Y.

WANTED: All types plastic scrap, film, chunks, bleeder stock. Surplus inventories, polyethylene, vinyl, styrene, nylon, etc. We are a multi-million dollar company. Deluxe Plastic Co., 20201 Hoover Road, Detroit 5, Michigan.

Molds for sale

BUTTON MOLDS FOR SALE, staple and fancy patterns. Preform machines, surplus stock, etc. Export Only. Merit Plastics, Lynbrook, New York.

ATTENTION CUSTOM MOLDERS, FOR SALE, PLASTIC MOLDS. Diversify now. Proprietary injection products. Long-established active consumer line doing $1,000,000 nationally. No equipment to buy. Includes all dies, assembly fixtures, etc. You are in business overnight. Selling chains, dept., stores, super marts, premiums, etc. Buy inventory at cost or less and pay when sold. Nothing for good will. Cash $50,000. Reply Box 6305, Modern Plastics.

Molds wanted

WISH TO PURCHASE Houseware Molds of all types for injection molding. Please submit full information. Reply Box 6315, Modern Plastics.

STEEL MOLDS FOR INJECTION MOLDING WANTED: Suitable for stationery, giftwares, noveities, purse, bar and barb-que use, for 4-6 oz. molding machine. Reply Box 6316, Modern Plastics.

WANTED: Three obsolete injection molds for experimental work. Must be in good operational shape. 1) 32 to 48 oz. shot, such as machine housing, radio cabinet, or big toy. 2) 16 to 24 oz. shot, such as breaker strip, freezer chest door, small radio, or grill. 3) 80 to 120 oz. shot, such as TV cabinet, door liner, or phono cabinet. We would consider a compression mold which could be converted. Please include part and mold drawings with price and location for inspection. Reply Box 6306, Modern Plastics.

Help wanted

PERSONNEL: Executive—Technical—Sale—Production. Employers and Applicants—whatever your requirements, choose the Leader in Personnel Placement. Cadillac Associates, Inc., Clem Easly—Consultant to Plastics Industry, 29 E. Madison St., Chicago, Ill.—Wabash 2-4800. Call, write or wire—in confidence.

MARKET DEVELOPMENT: Opportunity to join Spencer Chemical Company's expanding Plastics Market Development program in a position which will permit the use of sales and technical abilities. We are seeking men who have a chemical or engineering background, and preferably three to five years' experience with thermo-plastics. Please send detailed resume to: W. H. Swope, Jr., Personnel Manager, Spencer Chemical Company, 610 Dwight Building, Kansas City 5, Missouri.

FILM EXTRUSION ENGINEERS: Expansion program has created openings in our Technical Department for experienced extrusion engineers. Positions cover wide range of development and process projects. Reply to Plastic Horizons, 1 Erie Street, Paterson, New Jersey.

TEFLON SALESMEN: Wanted by firmly established, East Coast processor and fabricator of Teflon in all phases: extruded Teflon rod (60 increments), "O" rings, stand-off and feed-thru electrical terminals, molding, custom precision machined components. Company now expanding operations and sales areas, needs top-notch Teflon salesmen. Salary commensurate with background and ability. Forward resume with requirements; all areas open. Replies held in strict confidence. Reply Box 6307, Modern Plastics.

PLASTIC ENGINEERS: openings in Applications Research Laboratory in North Jersey Metropolitan area. Degree in Chemical or Mechanical engineering required; some experience in extrusion, injection molding or compression molding of plastics desirable. Positions involve laboratory applications work and customer service. Liberal company benefits. Send complete resume and salary requirements to: Personnel Department, Plastics and Coal Chemicals Division, Allied Chemical Corp., 40 Rector St., New York 6, N.Y.

PLASTIC Laminating & Printing Foreman. Dept. Supervisor to take charge of Laminating & Printing Dept. Must have thorough knowledge of all phases including color matching & valley printing. Excellent salary & conditions. N. Y. City area. Reply Box 6308, Modern Plastics.

PLANT MANAGER: To have full responsibility of production and maintenance, injection molding plant. Excellent position and opportunity. Send full resume of experience and salary requirements. All replies treated confidentially. Reply Box 6309, Modern Plastics.

PLASTIC SALES: Technical salesmen for Eastern district, selling plastic material to molders and "end users". Good opportunity with a growing product. Write W. Stewart, United Cork Companies, Kearny, N. J.

DESIGN AND DEVELOPMENT ENGINEER: For creative position with National Company in suburban New York. M. E. preferred. Background in package machinery, plastics processing or automation helpful. Should be able to take project from drawing board to production. Opportunity for advancement to management position. Send resumes to Box 6310, Modern Plastics.

INJECTION SUPT. CHICAGO AREA: Custom molder with six Reed-Prentice machines requires man to run pressroom, cycle new molds and train operators. Must be neat workman and know quality molding. Good opportunity and compensation for top quality man. Reply Box 6311, Modern Plastics.

FINISHING ROOM SUPERINTENDENT: Must have experience in all types of finishing procedures for compression, transfer and injection molded parts. Minnesota location. Salary open. Please give complete resume in first letter. Reply Box 6312, Modern Plastics.

ASST. PLANT MGR. — PLASTICS — Exceptionally fine position with young, Southern New England growth company for young engineer or chemist. Require thorough technical and administrative background in injection molding. We are looking for a bright young man on way up who is ready for the big step. Inquiries treated confidentially. Reply Box 6317, Modern Plastics.

PLANT SUPERINTENDENT: Progressive Chicago corporation has exceptional position for man with sheet extrusion and vacuum forming experience. Man should have good extrusion background and ability to handle mechanical production problems. This is a permanent position offering growth and developmental opportunities. Good salary commensurate with ability. Excellent working conditions. Replies confidential. Reply Box 6318, Modern Plastics.

DESIGN ENGINEER: Aggressive responsible engineer who can get things done quickly and accurately. Degree or equivalent, with machinery design experience and perferably some knowledge of plastics extrusion. To assist Chief Engineer in supervision of extruder design department. Please write describing experience, education, salary requirements to A. W. Pomper, Director of Engineering, Waldron-Hartig Division of Midland Ross Corp. P.O. Box 791, New Brunswick, N.J.

BLOW MOLDING SALES REPRESENTATIVES—Several top men for Metropolitan New York, New England area and Middle Atlantic States. Company is outstanding in blow molding facilities and skills; help build low cost molds, fullest engineering assistance. Advanced process for toys, bottles, containers, figures, other hollow articles. Low quotations. Commission basis—send details. Star Plastic Specialties—215 A St. Boston, Mass.

PLASTIC BOTTLES: Manufacturer seeks blow molding production man with heavy experience in bottles to take full charge of bottle production. Modern New York City plant. Excellent opportunity. Write giving full details including experience and salary desired. Reply Box 6319, Modern Plastics.

CHEMICAL ENGINEER: (Vinyl Plastisol Coated Fabrics). Large national manufacturer of building materials is expanding its Midwest facilities and needs a vinyl plastisol formulation chemist with color experience. Other resin problems involved. Salary open: retirement and other fringe benefits. Resumes held in strict confidence. Reply Box 6320, Modern Plastics.

POLYMER CHEMIST: JOHNS-MANVILLE CORPORATION: To do research and development on Polymers for use in the construction industry. Must have laboratory and pilot plant experience in the preparation of Thermoplastic Polymers. Attractive residential areas are near our Research Center. Replies will be held in strict confidence. Please write giving details of education, professional experience and salary requirements to Technical Personnel Manager, Johns-Manville Research Center, Manville, New Jersey.

OPENINGS FOR REPRESENTATIVES Throughout the country to solicit custom extrusion and injection molding business for large Ohio Plastics manufacturer with experience in automotive, appliance, housewares, toys, building products, premiums, rigid packaging and other fields. Reply giving qualifications, present representation and territory. Commission basis. Reply Box 6321, Modern Plastics.

CHEMIST OR CHEMICAL ENGINEER with experience in molding techniques—Here is a challenging opportunity for a young chemist on his way up. Growing company . . . leader in its field . . . is seeking man to head development of Molding Compounds.
The man we seek is young, eager, ready to strike out on his own. He will be in charge of developing molding compounds . . . and since this is a comparatively new area for us, he will do a considerable amount of bench work. This doesn't mean, however, that he will be tied to the bench. He will work closely with our Marketing and Sales group.
If you have from 4 to 7 years experience, with a sound knowledge of molding techniques (thermosetting preferred) we have a real opportunity for growth. Epoxy and Silicone Technology helpful.
We are situated in a small northeastern college town ideally suited for family living.
Full insurance, profit-sharing and retirement programs.
If this sounds interesting to you, send complete resume of experience and salary requirements to Box 6322, Modern Plastics. Confidential interview will be arranged.

WANTED: CHEMIST: Recent graduate for production control, development, and testing of thermoplastics with long established progressive plastics manufacturer located in metropolitan area. Write giving education, age, salary requirements, etc. Reply Box 6323, Modern Plastics.

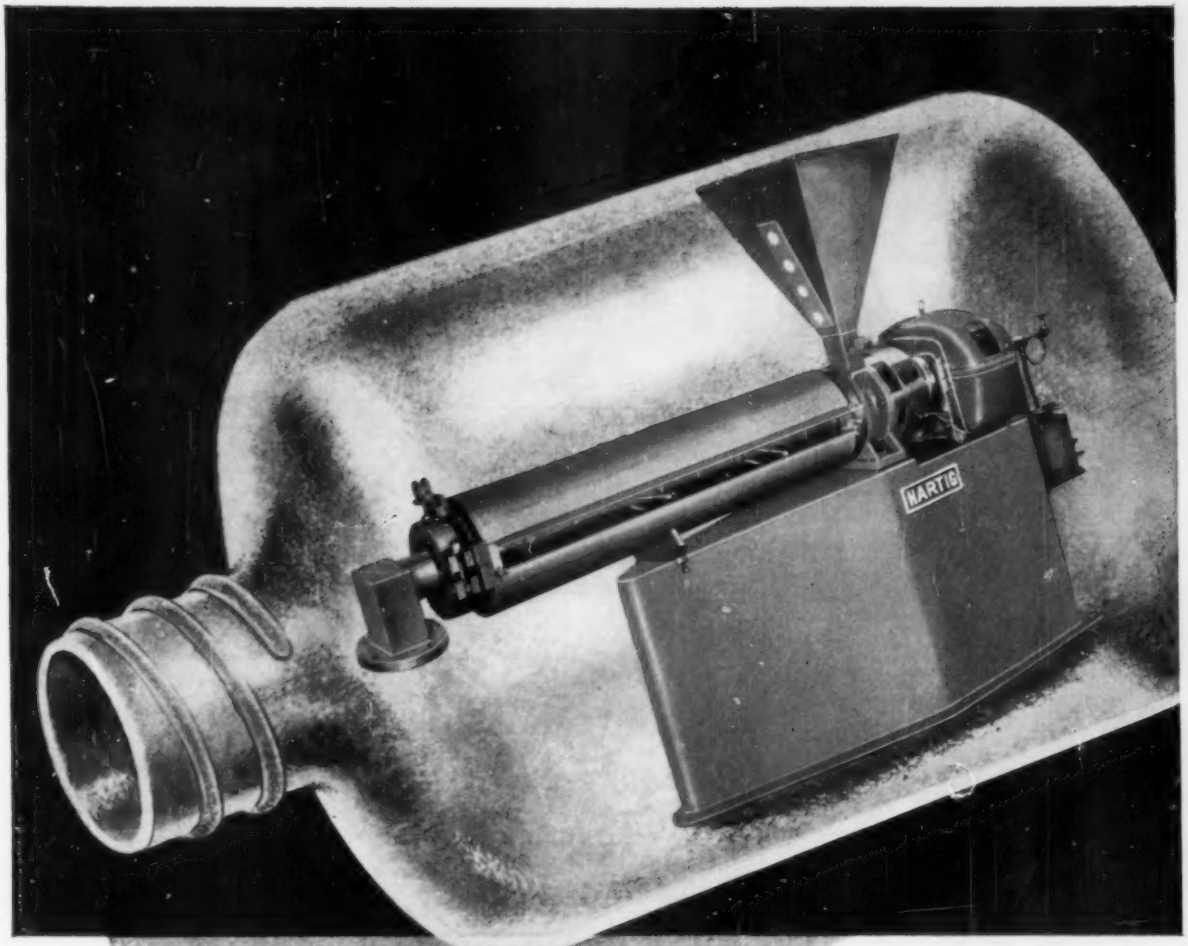
TECHNICAL SERVICE ENGINEER— Should have experience in the use of polyester resins in the production of reinforced plastics. This position involves considerable customer contact in addition to some work in our laboratories. This company is well established in the synthetic resin field and is the chemical subsidiary of the H. H. Robertson Co. and offers a generous line of fringe benefits. Interviews at the Conrad Hilton Hotel during the convention in Chicago, January 1215, or address replies to: Dr. Stephen E. Freeman. Freeman Chemical Corporation, 211 East Main Street, Port Washington, Wisconsin.

(*Continued on page 256*)

(*Continued from page 254*)

Situations wanted

Miscellaneous



Big in BOTTLES!

More Hartig Extruders are used in blow molding bottles than any other make.

There are good reasons for **Hartig's** popularity—dependable performance—prompt service. Inherent in all **Hartig** machines is a technical competence in design and manufacture that pays off in performance.

Typical of the **Hartig** Extruders for blow molding installations is the 2½"—21:1 L/D ratio extruder shown. With flamehardened SAE 4140 steel feed screw in a centrifugally cast Xaloy lined barrel, this machine features a four zone heating system—utilizing cast-in-aluminum heaters.

You'll be interested in the new Waldron-Hartig Bulletin LF-1 which gives the story on our laboratory facilities available for experimental and pilot plant studies. Write for your copy.

HARTIG EXTRUDERS

WALDRON-HARTIG DIVISION
Midland-Ross Corporation
P. O. Box 531 Westfield, N. J.

HE 160

EXTRUDERS • SPECIAL FEED SCREWS • MASTICATING HEADS • MANIFOLDS • DIES (ALL TYPES) • CONTROL PANELS • ACCESSORY EQUIPMENT

(*Continued from page 254*)

EXTRUSION TECHNICIAN to take charge of extrusion operation involving polyethylene and nylon monofilament. Applicant should have knowledge of extrusion machines, orientation, and coloring. Salary subject to experience. Reply Box 6324, Modern Plastics.

CREATIVE INDUSTRIAL DESIGNERS: Designers and product engineers wanted to staff our newly organized Design Department. Knowledge of materials, metal, plastics, wood, and their processing and fabrication desirable. Excellent opportunities with dynamic, young aggressive organization. Reply Box 6325, Modern Plastics, giving full particulars.

LARGE MANUFACTURER of injection molding machines needs man with injection molding experience to work in Sales Department as Sales Engineer. Should have engineering background and be familiar with plastic materials. Write, giving background, experience and salary expected. Reply Box 6326, Modern Plastics.

SOHIO CHEMICAL COMPANY—Wants: Needs: Expects To Hire: For Market Research and Product Development—2 Men: who like small company atmosphere and personal recognition combined with large company resources. 1 Man: Experienced in market research in fibers and/or thermoplastics. Prefer actual market research experience, but will consider men with adequate technical know-how and an interest in marketing. 1 Man: Experienced in the development and introductory sales of thermoplastic resins. Prefer 5 years development or technical service experience. Position will require man capable of starting with research results and carrying programs through to commercial sales. Please send confidential resume' and salary requirements to: R. S. Knight, Manager, Employee Relations, Sohio Chemical Company, P. O. Box 628, Lima, Ohio.

Situations wanted

PLANT SUPERINTENDENT—TECHNICAL DIRECTOR of large bulk Polystyrene and Polyurethane plants in South America. Extensive consultation work in final applications of these products. 10 yrs. previous experience in the States. Capable of supervising and assuming full responsibilities. Desire supervisory job in Plastics field in the United States. American citizen. Reply Box 6313, Modern Plastics.

DEVELOPMENT ENGINEER: Originated and put into production new polyester, vinyl, epoxies, styrene building panels, curtain walls, insulation, chalk board, plastic coated cinder blocks, table tops, and floor tile. Patent applications. 20 years with plastics on management level. Complete charge of R & D, inception to production. Interested in challenging new project on consultation or employment. Reply Box 6327, Modern Plastics.

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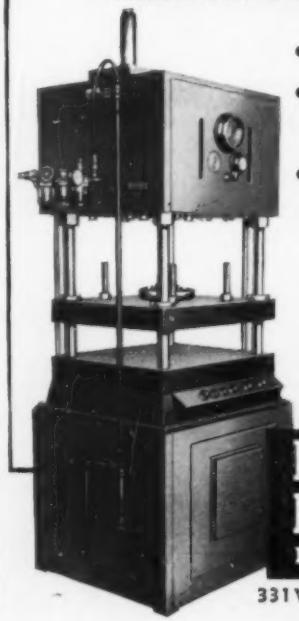
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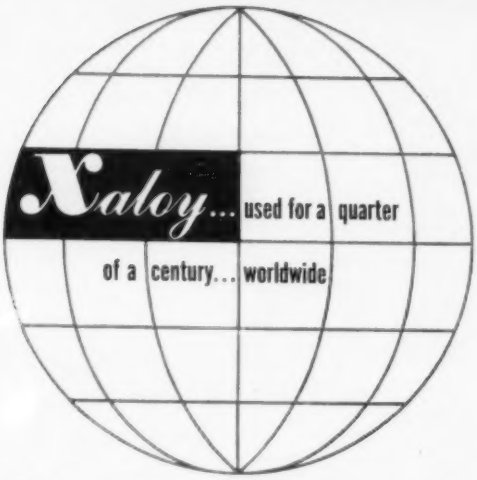
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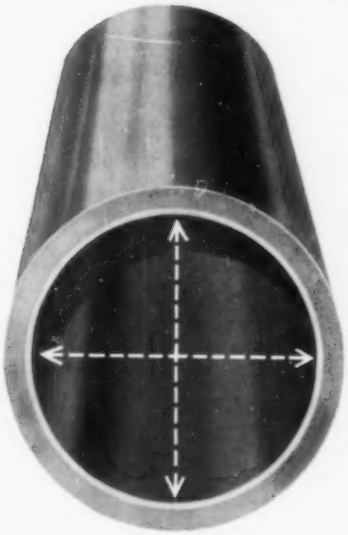
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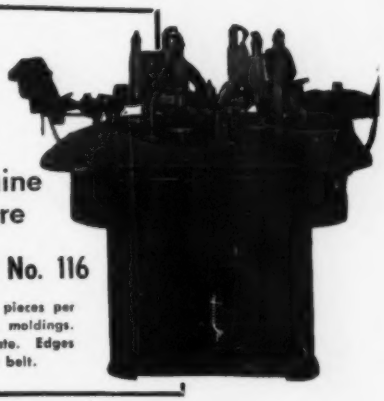
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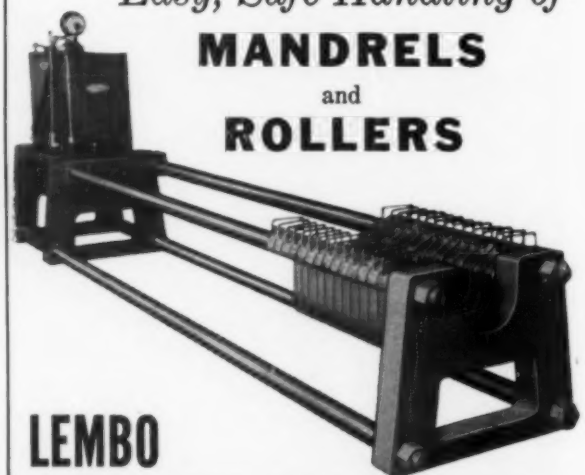
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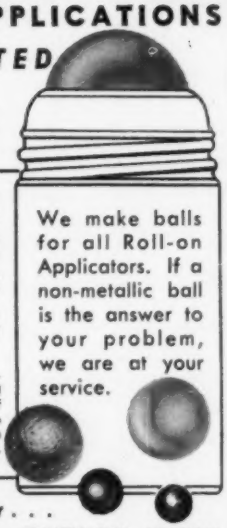
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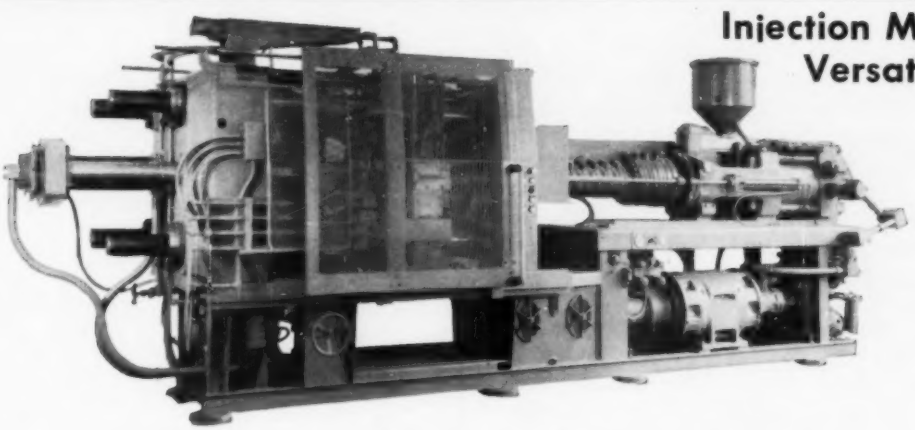
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EDITORIAL

Image of the plastics industries

As announced on page 89 of this issue, and as analyzed on the pages following, production of plastics reached 5,500,000,000 lb. in 1959. Up a billion lb.—more than 25%—in one year.

Soon we may have to present plastics statistics in tons, rather than pounds. We have already passed aluminum, the total use of which in 1959 amounted to only 5,034 million pounds.

Soon, too, we are going to have to stop presenting ourselves as a "brash young industry" to be admired for our annual growth and to be forgiven our mistakes because of our youth.

Actually, there is no such thing as a "plastics industry" at either material maker or processor level, as there is a steel industry, an aluminum industry or a glass industry.

The makers of plastics materials include six petroleum companies, five rubber companies, salt miners, explosive makers, textile companies, paint makers, drug manufacturers, electrical goods companies, even glass, steel and aluminum companies, steamship lines, and banks.

Was there ever in all history such a heterogeneous collection of industrial philosophies, such a variety of approaches to financing, manufacture, pricing, and distribution, all directed towards the building of production and sales of a range of materials that already exceeds the property ranges of all other materials combined?

At processor level we have plastics industries in housewares, toys, automobiles, electrical and electronic products, pipe, furniture, building materials, aircraft, packaging, missiles and many other forms of finished goods—plus the large number of custom molders, extruders, calenderers, coaters, casters, laminators and fabricators.

Yet, for the sake of our future, it is vital that we speak with one voice—and that we speak as an adult group of industries. The image we present is important. We submit that the whole purpose of the plastics industries is to build BETTER products and offer BETTER values. By each company, no matter what its basic interest, cleaving to that purpose, we have achieved our present volume.

As we enter what promises to be the "soaring sixties," let's live up to our new role as major factors in the American economy. Let's maintain our hard-won standards of quality. We're big business now. Let's act it.



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In metallizing, the molded piece must be shrink-free, for the coating blows up distortions. The surface must be smooth, bondable. And the molding must be able to take the heat of the metallizing oven. Phenolics fill the bill admirably.

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